Early Bronze Age Society in Eastern Arabia: An Analysis of the Funerary Archaeology of the Hafit Period (3,200-2,500 BC) in the Northern Oman Peninsula with Special Reference to the Al-Batinah Region

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The main focus of this research is on the funerary archaeology of the Hafit period (3,200-2,500 BC) in Early Bronze Age eastern Arabia, particularly within the Al-Batinah region of Oman. Notwithstanding the period's lengthy research history our understanding of Hafit society is still very limited, while despite its importance little archaeological research has been carried out in Al-Batinah. The aim of the thesis is to explore the Batinah's Hafit archaeological dataset within the context of the northern Oman Peninsula and the wider region in order to consolidate our understanding of Hafit society. Google Earth is used to map the relative density and ubiquity of Hafit tombs across the northern Oman Peninsula, and to estimate the number of surviving Hafit tombs and the average size of the Hafit population. The location of every visible Hafit tomb in the Batinah region is also mapped. GIS analysis is carried out on both of these datasets in order to model the distribution of Hafit tombs in the Batinah and more broadly across the northern Oman Peninsula. To complement this regional analysis, three Hafit cemeteries and a suspected Hafit settlement are surveyed and recorded in detail on the ground. All of this data is brought together along with the published evidence in an attempt to provide fresh insight into the nature of Hafit society. Subsistence, the wider economy, and politics and ideology are discussed in detail. The importance of nomadic pastoralism, water resources, copper, and local and international trade emerge as major themes, as does the development of the Hafit economy and social structures later in the period. The wider geographical context is also examined — the phenomenon of widespread stone tomb construction in the fourth and third millennia BC across southwest Asia, and what this may reveal about Hafit society.

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Glossary

ArcGIS a suite of geographic information system software used for mapping and analysing spatial data; versions 9.3 and 10.2 of ArcMap and ArcCatalogue were used in this thesis

attribute table a GIS table containing data relating to a set of geographical features

basemap a background map provided by a GIS program of satellite imagery, political boundaries or other geographical information

Buffer Tool an ArcGIS tool for creating a polygon zone of specified distance around a geographical feature

Calculate Geometry an ArcGIS menu option from the attribute table that allows geographical information such as coordinates, length or area to be calculated for geographical features

Clip Tool an ArcGIS tool for delimiting geographical features to the boundaries of another geographical feature

Create Fishnet Tool an ArcGIS tool for creating a regular grid of lines or polygons in which the number, size and position of the units is determined by the user

Digital Globe a company that captures and distributes high resolution satellite imagery, including to Google Earth

digital elevation model a three-dimensional model of a terrain's surface

Dissolve Tool an ArcGIS tool to remove boundaries between adjacent geographical features based on shared specified attributes

DIVA-GIS a GIS program that provides free geographical data

Erase Tool an ArcGIS tool that removes geographical data from features from an area defined by another geographical feature

Euclidean Distance Tool an ArcGIS tool that calculates the nearest linear distance between two sets of geographical features

Extract Values to Points Tool an ArcGIS tool that extracts values from a raster of spatial data to a set of geographical point features

feature class a collection of geographical features in vector form — either points, lines or polygons

Field Calculater an ArcGIS menu option from the attribute table that allows values to be generated for fields based on others within the table

Focal Statistics Tool an ArcGIS tool that generates a raster in which the value for each cell is a function of data within a specified neighbourhood around it

For Iterator an option within the ArcGIS ModelBuilder that allows an analysis task to be repeated a specific number of times based on a specified starting and ending value

Generate Near Table Tool an ArcGIS tool that measures the distances between one or more sets of geographical features, producing a table as output

georeferenced a geographical dataset, especially a map or aerial/satellite image, that has been ascribed with a spatial location

GeoTIFF a TIFF image with extra metadata containing spatial information allowing it to be displayed in GIS software

GIS geographic information systems — a digital means of storing, analysing and presenting spatial data

Historical Imagery Tool a Google Earth tool for selecting satellite imagery of different dates for display

Hydrological Toolset a set of ArcGIS tools that use elevation data to model the flow of water across a surface

Intersect Tool an ArcGIS tool to generate a new feature class based on the overlap between two sets of geographical features

Iterator Feature Selection an option within the ArcGIS ModelBuilder that allows an analysis task to be repeated multiple times for each specified group of fields in a geographical set of features

Join a means of reversibly combining two attribute tables in ArcGIS based on a common field in the attribute tables

KML keyhole markup language — the native filetype format for the export and import of geographical features in Google Earth

Layer to KML Tool an ArcGIS tool for exporting a set of geographical features as a format compatible for display in Google Earth

ModelBuilder an ArcGIS application for visually programming a workflow of tasks using geographical datasets and ArcGIS tools

Merge Tool an ArcGIS tool for combining two sets of geographical features into a single file

Multipart to Singlepart Tool an ArcGIS tool for 'exploding' a set of geographical features so that each spatially discrete feature has its own entry in the attribute table

Natural Earth a public domain map dataset providing global geographical data for physical and political features at multiple scales

Near Tool an ArcGIS tool that calculates the distance between each geographical feature of one set and the nearest feature of another

Placemark a Google Earth tool for placing a geographical feature as a single point

Point Density Tool an ArcGIS tool that calculates the density of point-based geographic features and generates a raster as output

Polygon a geographical feature that takes the form of a 2-dimensional shape

Polygon to Raster Tool an ArcGIS tool that converts a set of geographic polygon features into a raster

raster a form of geographic data in GIS that displays data as a matrix of cells of the same size, organised regularly as rows and columns, that produces a digital image-like effect

Raster Calculator Tool an ArcGIS tool used to create a new raster based on one or more others and or constants in a mathematical formula

Raster to Polyline Tool an ArcGIS tool that converts a raster representing linear features into vector-based geographic features

Reclassify Tool an ArcGIS tool that changes the values of a raster by reclassifying them into new values defined by the user

Select Layer By Location Tool an ArcGIS tool that selects a subset of geographical features based on a spatial relationship with another set

shapefile a native ArcGIS data format for vector-based geographical features — either points, lines or polygons

Slope Tool an ArcGIS tool that generates a raster of the gradient of a surface based on a digital elevation model

Spatial Join Tool an ArcGIS tool for relating two sets of geographical features based on a specified spatial relationship

Zonal Statistics as Table Tool an ArcGIS tool that statistically summarises a raster dataset based on user-defined zones of unique values in a second raster or a set of polygons

Terminology and abbreviations

12 arcsecond Batinah Google Earth (12" B-GE) survey the second and final phase of the full Batinah Google Earth survey described in Chapter 5.3.1 in which areas known to have Hafit tombs and Later Prehistoric Tombs (from the 1km B-GE survey) were resurveyed at a greater magnification using Google Earth's 12 arcsecond grid in an attempt to more reliably distinguish tomb types

1km Batinah Google Earth (1km B-GE) survey the first phase of the full Batinah Google Earth survey described in Chapter 5.3.1 in which the location of suspected Hafit and Later Prehistoric Tombs was mapped across the whole of the Batinah using a 1km survey grid

Agglomeration from the analysis of the Batinah Google Earth survey results, a group of Hafit or Later Prehistoric Tombs that are all within 4km of at least one neighbour

Batinah Google Earth (B-GE) survey the Google Earth-based, remote sensing survey described in Chapter 5 that maps the location of every Hafit tomb visible on satellite imagery in the Batinah, as well as that of Later Prehistoric Tombs

Batinah Google Earth (B-GE) transect survey an early stage of the Batinah Google Earth survey in which the 1km method was trialled in six 10km transects from across the Batinah

Cell Grave a Later Prehistoric Tomb common in the Batinah and found elsewhere in the northern Oman Peninsula; usually an oval tomb ~4x2.5m in size with a double wall packed with gravel and small stones that can be detached or agglomerated to form large, multiple-chambered tombs; probably date to the Early or Late Iron Age; may be related to hut graves that are common in other parts of the region and which share many architectural similarities

Cluster from the analysis of the Batinah Google Earth survey results, a group of Hafit or Later Prehistoric Tombs that are all within 100m of at least one neighbour

Desert Surface Survey (DSS) an attempt to located and record Hafit settlement remains from a Hafit cemetery at al-Buyraq in the northern part of Rustaq *wilaya*, described in Chapter 7

Honeycomb Tomb a Later Prehistoric Tomb type first excavated at Bawsher but also found elsewhere in the Batinah and the northern Oman Peninsula; a low, multiple-chambered tomb built of stones of varying sizes, the chambers may be semi-subterranean, and are small and irregularly shaped, agglomerated together to form a single structure; probably date to the Early or Late Iron Age

Later Prehistoric Tomb (LPT) a stone, above-ground tomb built after the Hafit period, but sharing some similarities, and thus can be mistaken for Hafit tombs in the field or on satellite imagery; in the Batinah mainly consists of Cell Graves, with a much smaller number of Honeycomb Tombs, as well as other types including Wadi Suq tombs

Necropolis from the analysis of the Batinah Google Earth survey results, a group of Hafit or Later Prehistoric Tombs that are all within 1km of at least one neighbour; this term has a precise meaning in the context of the thesis beyond its general use in archaeology (unlike e.g. 'cemetery')

Northern Oman Peninsula Google Earth (NOP-GE) survey a low-resolution, Google Earth-based remote sensing survey described in Chapter 4 that uses sampling-based approach to map the relative density and ubiquity of Hafit tombs in a 10km grid across the northern Oman Peninsula

Rustaq-Batinah Archaeological Survey (RBAS) a joint Durham/Sultan Qaboos University multi-period archaeological survey project examining ancient settlement in the Batinah *wilayat* of Rustaq, Suwayq and Mussanah

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Finally thanks to my family who assisted and supported me in my fieldwork; especially to Dad, Harri and Abi for their willingness to join me out in the Batinah.

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This work is dedicated to my family, celebrating the wonderful years we spent in Oman together, and to Abigail my dear wife — thank you all for everything. To God be the glory.

Introduction

Despite a lengthy history of research rivalling any period in the northern Oman Peninsula, very little is known about late fourth and early third millennium BC society in the region. This is the Hafit period (3,200–2,500 BC), the earlier phase of the Early Bronze Age in northern Oman and the United Arab Emirates (U.A.E.). Many of the most fundamental questions regarding the economy and socio-political organisation of the Hafit population do not yet have concrete answers.

Following on from the Neolithic in the late fourth millennium BC, the Hafit period represents a major watershed in the prehistory of the northern Oman Peninsula. During this time thousands of small, tower-like stone tombs were built on hills and ridges; prior to this the dead had been buried in simple pits (e.g. Salvatori 2007). Although outlying cemeteries reach as far west as the al-Gharbia region of Abu Dhabi, the core distribution of the tombs lies around the Hajar Mountains, from Ras al Khaimah to the Sharqiyah coast of Oman. Hafit tombs are circular, drystone tombs, with one or more ringwalls corbelled to form a single chamber with a false dome roof; they show considerable architectural variation, but on average they are 4–6m in diameter and ~2m high when in good condition. In stark contrast to the tombs, Hafit settlement evidence is very rare and its identification is often contentious. The funerary structures were some of the first archaeological remains to be excavated in Oman, and were dated by the recovery of Mesopotamian Jemdet Nasr/Early Dynastic pottery which is a frequent component of the funerary assemblage of Hafit tombs. Simple copper tools were also commonly included as grave goods, suggesting that the period marked the beginning of the smelting, working and trading of the metal in the region; Uruk textual evidence and chemical analysis of Mesopotamian copper artefacts supports this (Potts 2009: 31; Begemann et al. 2010). More than a hundred Hafit tombs have been excavated and thousands recorded in archaeological surveys. However, despite the abundance of the Hafit funerary archaeology and the long history and prolificacy of the published literature, relatively little effort has been made to discover the nature of Hafit society. If archaeologists are not trying to understand the human past better then we are in danger of engaging in nothing more than the retrieval and ordering of data.

The geography of the northern Oman Peninsula

The northern Oman Peninsula lies at the very eastern extremity of Arabia and encompasses both the U.A.E. and the north of the Sultanate of Oman, forming the landmass that separates the Arabian/Persian Gulf to the west from the Gulf of Oman and the Indian Ocean to the east (Figure 1). The Tropic of Cancer passes straight through the region, endowing it with a hot and arid climate with summer temperatures occasionally reaching 50°C (Ministry of Information 2016: 12; Isaac 2004: 7). Rainfall is characteristically low — typically between 55 and 255mm/yr — and usually occurs in the milder winter months (Parker and Goudie 2008: 459; Fleitmann, Burns, et al. 2007: 173).

Figure 1: The northern Oman Peninsula, data from Natural Earth and Blue Marble Next Generation

The major geographical feature of the northern Oman Peninsula is the al-Hajar Mountain range that runs in a 700km arc through the region from the north to the southeast; its width varies between 30 and 130km and it reaches a height of ~3,000m at Jabal Shams in Jabal Akhder (Magee 2014: 15; Glennie, Boeuf, et al. 1974: 19). Geologically the core of the mountains is a limestone unit that falls away steeply firstly to low weathered hills of younger sedimentary Hawasina formations and ophiolite, then Tertiary limestones and sandstones, and finally Quaternary sediments lain down by large wadis flowing down steeply from the uplands (Luedeling and Buerkert 2008: 1183); to the southeast and the west, low foothills give way to the aeolian dunes of the Sharqiyah/Wahiba Sands and the northern fringe of the Rub' al-Khali (Figure 2). As well as significant crude oil resources that are central to the current Omani and Emirati economies (Ministry of Information 2016: 269–270), the northern Oman Peninsula also boasts considerable copper ore deposits that are mostly contained within the ophiolite (Weeks 2003: 12–14), as well as soft stone originating in the same sequences which was an important resource in antiquity (David 2002). Traditionally — prior to rapid urbanisation in the last fifty years following increasing oil exploitation — the population of the region was concentrated in the mountains, foothills and the proximate plains where water could be sourced for arable agriculture reliant on the date palm, and along the lengthy coastline in fishing settlements, the vast majority of the flat desert interior was inhabited by only a tiny proportion of the population that were nomadic, with many of these groups residing in or around sedentary agricultural settlements for at least part of the year (Wilkinson 1977: 16–19; Lancaster and Lancaster 2002: 239).

The climate of the region has varied markedly over the course of the Holocene, belying the image of Arabia as a timelessly hostile and desolate environment (Magee 2014: 41–43). The region lies at the interface of two weather systems, the Mediterranean and the Indian Ocean Monsoon, on the Intertropical Convergence Zone (ITCZ) with precipitation deriving from the northwest in the winter above this line and from the southeast in the summer below it (Fleitmann, Burns, et al. 2007: 170–173). The northerly and southerly migrations of the ITCZ over the course of the Holocene have determined changes in the volume, source and timing of rainfall over time (Fuchs and Buerkert 2008). This has been investigated through the analysis of evidence derived from, and often combining, speleothems (Fleitmann, Burns, et al. 2007), lacustrine sediments (Preston et al. 2015; Fuchs and Buerkert 2008; Parker, Davies, et al. 2006), aeolian sediments (Preusser 2009; Glennie and Singhvi 2002), and floral and faunal remains (Lézine, Robert, et al. 2010; Radies et al. 2005). Although there are differences in the detail, the results of these and other investigations combine to provide a consistent, broad picture of climate change over the course of the Holocene in the northern Oman Peninsula: a moist phase during the early-to mid-Holocene dominated by the Indian Ocean Monsoon system that came to an end around 4,000 BC, followed by an arid phase for most of the next thousand years, and then a return to slightly moister conditions derived from winter/spring rainfall that gradually declined until a major aridification event at 2,100 BC that marks the start of the dry climate that continues, with some variation, until today (Preston et al. 2015: 279; Magee 2014: 42–45; Parker and Goudie

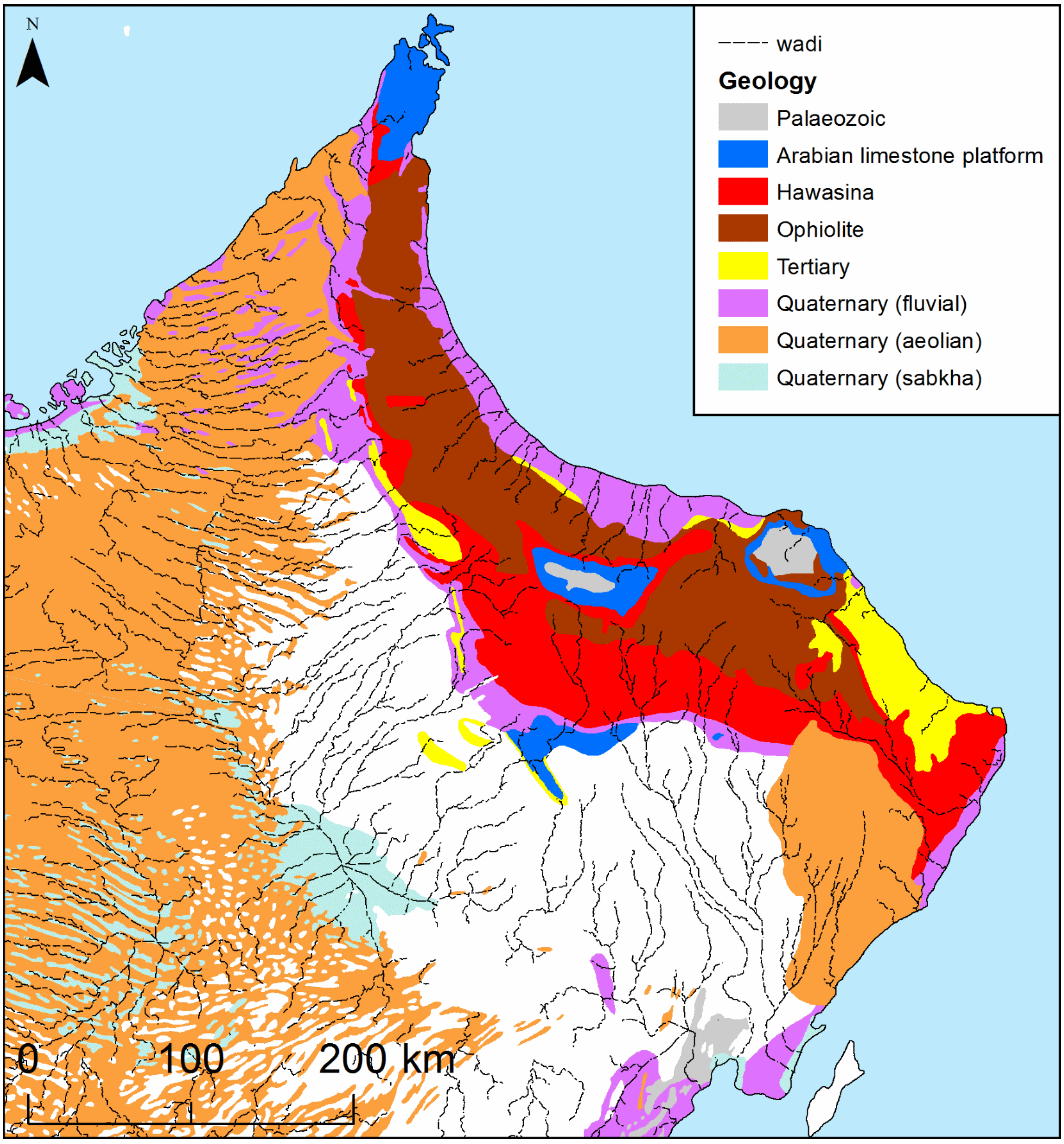


Figure 2: Simplified geological map of the northern Oman Peninsula, data from geo2bg (USGS)

2008: 458). The clearest evidence for the Hafit period climate comes from palaeolake cores from Awafi in the northern U.A.E. which suggest the prevalence of modestly moist conditions throughout much of the Early Bronze Age (Parker, Goudie, et al. 2006: 472); comparisons between the speleothem records of northern Oman and northern Yemen suggest that most of precipitation would have originated from the Mediterranean and would have fallen in the winter or the spring (Fleitmann and Matter 2009: 640). Pollen and micropalaeontological analyses from eastern Oman agree with this picture, with climatic conditions similar to the modern day prevailing from the second half of the third millennium BC (Lézine, Saliège, et al. 2002: 229).

Al-Batinah

The Batinah region is made up of two of the eleven governorates of the Sultanate of Oman and lies immediately west of the capital Muscat; it is situated on the Gulf of Oman coast, bordering the U.A.E. to the northwest and Dakhiliyah, Dhahirah and Buraimi to the south and west on the other side of the Hajar Mountains (Figure 3). The lofty limestone uplands give way first to copper-rich ophiolite and other rocky foothills and then a lower bajada zone before flattening out in a wide gravel plain that stretches to the sea; in this littoral area the freshwater that flows down from the mountains, sinking into the gravels of the plain, is brought to the surface by the intrusion of denser salt water from the sea beneath it (Figure 4). Modern settlement is concentrated mainly in this area where sediments suitable for arable farming are available and the groundwater is easily accessible with wells (Costa and Wilkinson 1987: 31–33). A much lower number of villages are also located in the uplands and foothills of the Hajar Mountains, while the middle of the Batinah plain is left largely empty (Figure 5). Such is the richness of the Batinah littoral zone that arable farmland forms an almost unbroken strip across it (Wilkinson 1977: 8), accounting for over half of Omani cultivated land and supporting over a quarter of the modern population despite covering less than 5% of the total area (Zekri 2008: 243; Ministry of Information 2016: 18). Moreover, the richness of the Gulf of Oman allows the region to also support over a third of the country's traditional fishermen (al-Oufi et al. 2000: 423). Lorimer's and Wilkinson's accounts of Oman's traditional economy suggest that the Batinah was at least as significant prior to oil-exploration and the modernisation of the sultanate (Lorimer 1908: 1386–1388, 1411; Wilkinson 1977: 17). However, despite the clear modern and historical significance of Al-Batinah, relatively little archaeological research has been carried out there.

Compared to other regions very few of Oman's major known archaeological sites are located in the Batinah. This major gap in our understanding is the result of a dearth of archaeological research in the region. The first archaeological investigations to be carried out in the region were a series of excavations undertaken in Sohar in the 1950s (Cleveland 1959; Phillips 1971). As Oman became less politically insular in the 1970s, a number of archaeological survey teams began to explore the country, but apart from some brief research by the Danish team in Wadi Jizzi (Frifelt 1975b), they focused their efforts on the other side of the Hajar Mountains (Hastings et al. 1975; de Cardi, Collier, et al. 1976); this largely reflects the status quo of modern archaeological research. The discovery of ancient mining sites in the copper-rich ophiolite of the Batinah (Goettler et al. 1976) temporarily enhanced interest in the metallurgical heritage of the region (Weisgerber 1978; Hauptmann 1985). Costa and Wilkinson (1987) carried out a thorough study of Sohar's hinterland and some limited surveys further inland, but very

Figure 3: The Batinah region and the governorates of northern Oman, data from d-maps and Blue Marble Next Generation

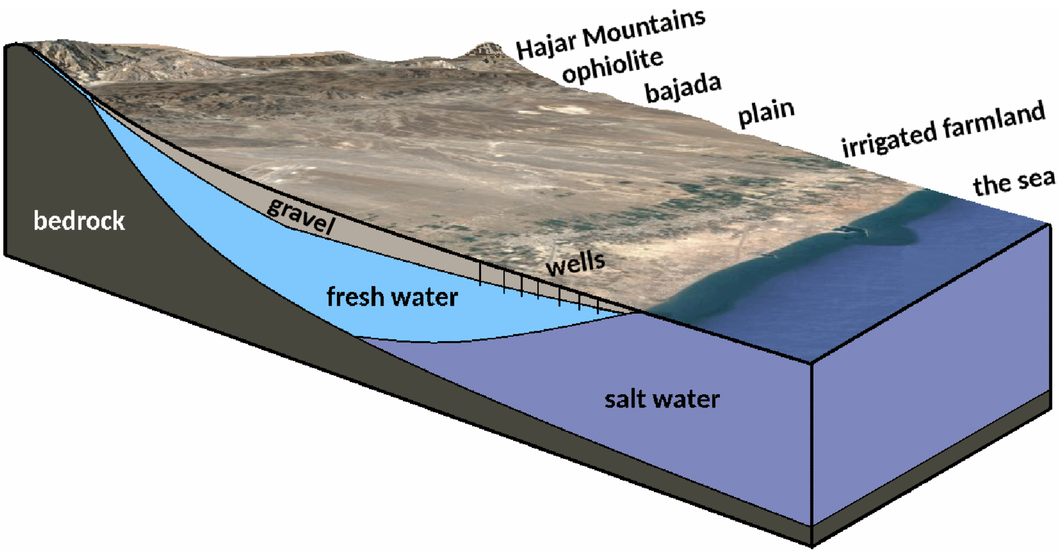


Figure 4: A hydrological section through the Batinah, based on Costa and Wilkinson (1987: figure 5), imagery from Google Earth

little archaeological research has been carried out in the Batinah in the last forty years. Only very recently — and partly due to the development of modern infrastructure —

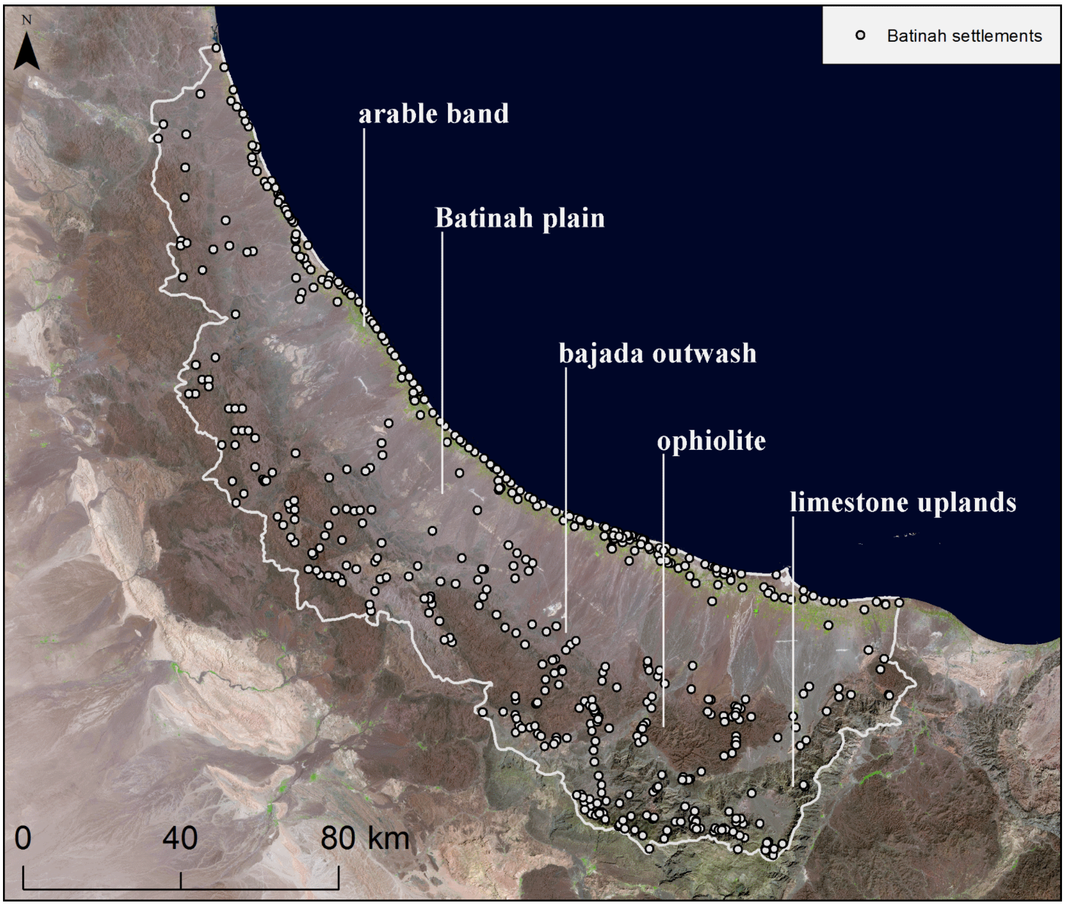


Figure 5: Landsat imagery of the Batinah region and the distribution of modern settlements within the major geographical zones, for data source see Chapter 4.5.1

have teams started to explore the region (al-Jahwari, al-Muzini, et al. 2014; Düring and Olijdam 2015; Kennet, Deadman, et al. 2016; Saunders 2016). Very little is known about the Batinah during the Hafit period; indeed, of the more than one hundred Hafit cemeteries known prior to the present author's research in the region, fewer than five were recorded in Al-Batinah (see Appendix A.1). Given that the Batinah encompasses large stretches of the rocky foothills that contain significant numbers of the tombs in other regions of Oman one would expect it to have supported a sizeable Hafit population, and yet the lack of archaeological research has meant that virtually nothing is known about the Early Bronze Age occupation of the area.

Aims and objectives

The aim of this thesis is to explore the Hafit archaeological dataset of the Batinah within the context of the northern Oman Peninsula and the wider region, in order to consolidate our understanding of Hafit society.

This will be achieved through the completion of the following objectives:

1. Complete a literature review summarising the Hafit archaeological dataset, and reviewing past and current opinion on the economic and socio-political organisation of Hafit society

A meticulous investigation of the Hafit dataset is crucial as no such review currently exists in the published literature. A full summary of published opinion on the nature of Hafit society will demonstrate the existence of the significant gaps in our knowledge of the subject. Both literature reviews will be drawn heavily upon in later discussions of Hafit society, and so complete and concise ordering of the information is vital.

2. Map and analyse the relative density of Hafit tombs across the northern Oman Peninsula

Despite the large number of Hafit cemeteries that are known across the region a substantial research bias exists in the literature that favours certain areas, inhibiting any attempt to map the distribution of Hafit tombs across the northern Oman Peninsula as a whole. A single survey mapping the relative density of the tombs across the whole region will negate this bias. It will provide a consistent dataset with which to compare to the Batinah tomb distribution, and through analysis will provide its own insights into the socio-political and economic organisation of Hafit society at a broad level.

3. Map and analyse the distribution of Hafit tombs in the Batinah region

With so few Hafit cemetery sites known from Al-Batinah the published literature is able to provide very little insight into how the Hafit population occupied the region. In order to gain such insight the distribution of Hafit tombs will be mapped across the entire region. This will reveal which parts of the Batinah were most heavily exploited by the population, while analysis of the distribution should begin to reveal the reasons behind such preferences. Such a survey will immeasurably increase our understanding of Hafit archaeology and Hafit society in the Batinah.

4. Ground survey a sample of Batinah Hafit cemeteries

While broad, regional mapping and analysis of the Batinah Hafit tomb distribution should begin to reveal general patterns of the Hafit occupation of the region, more detailed survey cannot be neglected. Detailed examination of the architecture and distribution of Hafit tombs in individual cemeteries will provide an additional level of detail to the picture of Hafit archaeology and society in the Batinah. This extra dimension is critical in ensuring that discussion of the Hafit economy and social and political organisation is grounded in evidence from the local landscapes of the region.

5. Locate and survey a Batinah Hafit settlement site

While the conspicuous Hafit funerary dataset provides an elegant means of exploring the Hafit occupation of the Batinah and the wider region, it is important not to sidestep the issue of contemporary settlement remains. Settlement sites should provide the most direct evidence for Hafit economy and lifestyle, but they are notoriously difficult to find and even harder to accurately date. Nevertheless an attempt to locate a Batinah Hafit settlement must be made in order to go some way towards balancing an otherwise heavy reliance on tombs. If such a site was located and added to the very few known examples it would have the potential to add enormously to our understanding of the Hafit occupation of the Batinah and the wider region.

6. Assess the results in the context of the literature to explore the nature of Hafit society in Al-Batinah and the northern Oman Peninsula

The evidence from each strand of investigation will be brought together alongside published data and opinion from the literature reviews in order to discuss what it all may reveal about the Hafit economy and socio-political organisation in the Batinah and the region as a whole.

7. Examine the wider geographical context of the Hafit archaeological dataset

While significant in its own right, the Hafit period is only part of a much larger story of the Neolithic and Bronze Age of Southwest Asia. This wider region is likely to have been highly significant in shaping Hafit society, and likewise the northern Oman Peninsula in all probability had an important place in regional geopolitics. The Hafit archaeological dataset will be examined in light of this broader context in order to begin to explore fourth and third millennia BC society in the northern Oman Peninsula and the wider region.

Remote sensing

This bold aim and ambitious set of objectives demand a rapid and accurate means of data collection if they are to be realised. Accordingly, remote sensing forms the core to the archaeological investigation in this thesis. It has already proven to be a worthwhile tool in the study of prehistoric stone tombs in eastern Arabia. The Bahrain Burial Mound project utilised aerial photographs taken by the RAF in 1959 to map the location of approximately 85,000 Early and Late Dilmun tombs; the images were mosaiced, georectified using a later map, and the mounds were digitised as polygons in GIS software (Laursen 2010; Højlund et al. 2008; Laursen and Johansen 2007). Although a highly-effective project, its approach relies on the existence and availability of high quality aerial photography which — for the region — is usually patchy in its coverage and difficult to obtain. The Ancient Human Social Dynamics project applied a remote sensing survey methodology to research the prehistoric stone tombs of eastern Yemen and southern Oman (Harrower, Schuetter, et al. 2013). As well as employing traditional ground survey, the project devised a means of automatically detecting the monuments on Quickbird satellite imagery through a complex algorithim (Schuetter et al. 2013). This novel approach has the potential to greatly enhance the study of stone tombs in arid environments, but it is currently at a developmental stage — with a success rate of between 50 and 88% (Harrower, Schuetter, et al. 2013: 264) — and it requires access to expensive, raw satellite imagery and specialist statistical and programming expertise. The present author has already utilised remote sensing to study Hafit tombs, using Google Earth to map the location of thousands of the funerary structures in the Wadi ‘Andam region in the east of the northern Oman Peninsula — a methodology that proved highly effective (Deadman 2012a).

Google Earth is free software that provides high-resolution satellite imagery with global coverage. It also provides a framework suitable for archaeological survey, with grids, tools for drawing exportable point, line and polygon data and an **Historical Imagery tool** that allows different imagery to be viewed for the same location. The satellite imagery itself consists of up-to-date, high-quality data that would be prohibitively expensive to an independent researcher — ‘remote sensing for the masses’ (Beck 2006). Although it is not possible to access the imagery for use or analysis in more advanced GIS software, there is no need to georectify, store or handle cumbersome data which are instead streamed over an internet connection.

Google Earth forms the basis of data collection in this thesis because of its ease of use, free availability and proven effectiveness in studying Hafit tombs. High-resolution satellite imagery is expensive if large areas need to be covered, and while some providers such as Digital Globe award grants they are generally restricted to a small surface area. Freely available data such as Landsat and Corona, invaluable in some archaeological contexts, are of insufficient resolution to reliably locate Hafit tombs.

Remote sensing consists of the interpretation of imagery and therefore cannot alone form a definitive interpretation of an archaeological site or feature (Bradbury 2011: 245). The reliability of the method must be carefully assessed, and where possible, remote data collection must be tested and verified by ground-truthing. The ordering and analysis of the large volumes of data generated by remote sensing survey require careful consideration. Geographic Information Systems (GIS) provides the perfect environment for this, and it has already been used successfully in the analysis of Hafit tomb distributions (Deadman 2012a). Localised and detailed field survey of individual cemeteries provides a necessary complement to the broader regional and landscape-based approach of remote sensing and GIS analysis. While despite the problems involved in such fieldwork, it is also important to engage with Hafit settlement evidence to balance the heavy reliance on the highly visible funerary archaeology of the period.

Approaching funerary archaeology

The thesis' approach to the study of the Hafit archaeological dataset follows in the tradition of mortuary analyses that emerged over half a century ago. Part of the new/processual archaeology movement (Binford 1962)BinfBinf68, novel means of interpreting the social structure of past societies from their funerary remains were developed during this time (cf. Brown 1971), mostly involving the analysis of ethnographic data (e.g. Binford 1971). Saxe's seminal research sought to develop means of reconstructing total sociocultural systems from the mortuary practices of past societies (1970; 1971). He sought to dissect these practices into their component parts in order to discover the underlying principles by which the social organisation of the society itself may be elucidated (Saxe 1970: 3). Saxe employs ethnographic data in order to test a series of eight hypotheses as to how a community's mortuary practices reflect its socio-political structure (1970: 64–122). Goldstein explored one of these hypotheses, testing it with further ethnographic data and altering and restating it as a result; Hypothesis 8 links the emergence of formal cemetery areas with competition for restricted local resources and attempts to control them through claims of lineal descent from the dead (1981: 61; 1976). The Saxe/Goldstein Hypothesis quickly influenced interpretations of funerary archaeology (e.g. Madsen 1982), and continues to do so in the current literature (e.g. Rowley-Conwy and Piper 2016). Similar contemporary approaches include: Renfrew's attempts to map prehistoric settlement patterns through an analysis of the spatial distribution of megalithic tombs (1976; 1973), which was quickly adopted by others (e.g. Darvill 1979); Tainter's application of complex statistical analysis of the expenditure of effort in mortuary practices to infer the scale of rank and status in past societies (1975b,a); Rothschild's cluster analysis of grave good inclusions to explore the role of age and sex in social organisation (1979); and, more broadly, the widespread application of the social typologies of Service (1962) and Fried (1967) in the interpretation of funerary archaeology (Tainter 1978: 114–117).

Such mortuary analyses — along with the wider theoretical stance — came under sharp, direct criticism from archaeologists associated with the post-processual movement. Hodder applied his own ethnographic evidence to demonstrate that funerary practices did not always directly and simply reflect the reality of social relations, as they could be influenced and altered by cultural attitudes to death (1980), and argued that the Saxe hypothesis presented a passive view of society that disregarded the ideological cultural context and the symbolic meaning of the tombs to the people that built them (1984: 53). Parker Pearson expressed similar concerns that the general approach of Saxe and others fails to take ideology, particularly the ideological manipulation of burial ritual, into account (1982: 99–101). Shanks and Tilley likewise criticised such analyses of mortuary practices as overly-simplistic and of little explanatory value (1987: 42–45; 1982: 152). Morris examines the Saxe/Goldstein Hypothesis directly and at length, concluding that it should not be assumed to describe a scientifically observed social reality as it clearly neglected the role of ideology and human agency, but that it could be applied as one of many ways to interpret the funerary archaeology of past societies (1991: 163).

There has been a positive response to the very reasonable criticisms levelled at the early mortuary analyses of new/processual archaeology. In his study of the megalithic tombs of Europe, Chapman takes a broad and inclusive approach that combines the Saxe/Goldstein hypothesis with other models and emphases (1981; 1995). Brown asserts that it is possible to combine the use of funerary evidence to interpret social organisation with an engagement with politics and ideology (1995: 21). O'Shea argues convincingly of the need to move away from ethnographical data and engage more directly with the unique characteristics of the archaeological record, and therefore to be more realistic regarding the extent to which analysis of funerary practices can uncover the social organisation of past societies, but also that such analyses should be used to deduce the ideology that governs the behaviour under study (1996: 9–16). Contemporary analytical approaches to the interpretation of funerary archaeology reflect a similar maturity, applying analytical tools and focuses from both traditions as appropriate for a particular dataset (e.g. Mitchell and Noble 2017; Velasco 2014). When early ideas, such as the Saxe/Goldstein hypothesis, are explored in contemporary research it is with a mature awareness of the strengths and weaknesses of the approach (Conolly 2015; Winter-Livneh et al. 2012).

Levels of engagement with the wider theoretical literature in funerary archaeological research in eastern Arabia have risen significantly in recent years. Cleuziou's interpretation of burial practices in the northern Oman Peninsula draw on ideas from numerous traditions. He frequently discusses the cultural evolution of prehistoric — especially Early Bronze Age — society in the region, referring repeatedly to an increasing social complexity that follows a uniquely Arabian path shaped both by the environment and the deliberate choices made by its inhabitants rather than by any foreign influence (Cleuziou 2009; 2007b; 2003; 2002b; 1998; Cleuziou and Tosi 1998). His analysis of the Hafit funerary dataset is heavily influenced by the Saxe/Goldstein hypothesis (see above) and the related theme of territoriality (Chapman 1981; Renfrew 1976) — the tombs were constructed to mark ownership of specific, limited resources — including arable land, pasture and fishing grounds — and to mark the boundaries of tribal territories (Cleuziou 2007b; 2002b; 1997); there is a very strong emphasis on the role of ancestors as territorial guardians (e.g. Cleuziou and Tosi 2007: 116). Giraud's analysis of Early Bronze Age tombs centres around the definition and development of settlement patterns — she employs a geographic gravity model alongside GIS analyses to define the areas occupied by the Hafit population of Ja'alan and a settlement hierarchy and core-periphery network between these areas (Giraud 2009; 2007; Giraud and Cleuziou 2009). Bortolini applies neo-Darwinian archaeological theory and the use of cladistics analysis to the Early Bronze Age funerary dataset in order to explore architectural variation in the tombs over time (2012). Cable engages with a wide-range of archaeological theory in her study of the Early Bronze Age tombs and other monuments in and around the site of Bat, including the nature of landscapes, the role of monuments and the ideology of mortuary ritual; she argues that as well as marking access rights to critical resources as described by the Saxe/Goldstein hypothesis, the construction of Hafit tombs also provided a means of reinforcing an ideology of social integration (2012). The SoBO project integrates mortuary archaeology and bioarchaeology in an attempt to better understand the Early Bronze Age funerary landscapes of the Dhank area and in particular, citing Saxe and Binford, how they may reflect shifts in political and socio-economic complexity during the period (Williams and Gregoricka 2013: 146–147). Working in the neighbouring region of Southern Arabia, the RASA-AHSD project has examined the tombs and other monuments of the Neolithic and Bronze Age in Dhofar and Hadramawt, seeking to better understand the social, political and economic structures of these societies through survey, excavation, remote sensing and GIS analysis (Harrower, Senn, et al. 2014; McCorriston, Steimer-Herbet, et al. 2011). They employ a territoriality model, alongside a social boundary defense model (cf. Cashdan 1983), to explore access to resources in prehistoric nomadic pastoralist groups in the region, whilst also drawing on a broad range of other related archaeological theory surrounding mobility, pastoralism, cultural evolution and ideology (McCorriston, Harrower, Martin, et al. 2012; McCorriston 2013; Harrower 2008).

Thesis structure

The thesis is divided into three parts. The first is a literature review, and in Chapter 1 the Hafit archaeological dataset is examined, scrutinising both settlement and tomb evidence. Each settlement site claimed to have been occupied during the Hafit period is reviewed, and the available dating evidence for each is appraised. The architecture, distribution, furnishings and human osteoarchaeology of Hafit tombs is précised. In Chapter 2 published opinion as to the nature of Hafit society is summarised, from the earliest theories to the present.

The second part of the thesis consists of data collection and analysis. Chapter 3 presents an assessment of the reliability of Google Earth-based methodology in mapping the distribution of Hafit tombs. It makes use of the published results of a meticulous ground-based survey in northeastern Oman to measure the accuracy and precision of the remote sensing method. In Chapter 4 a survey of the density and ubiquity of Hafit tombs across the northern Oman Peninsula is presented. Using Google Earth and applying a sampling-based methodology, the relative distribution of Hafit tombs across the entire region is mapped as a grid of 10km squares. These ordinal results are quantified through the detailed remote sensing survey of a sample of the squares — from this an estimate of the total surviving number of Hafit tombs is calculated, as well as an approximation of the average size of the human population during the Hafit period. Finally, the survey results are analysed with GIS in order to explore the environmental and anthropogenic factors that influenced Hafit occupation of the northern Oman Peninsula. Chapter 5 describes a detailed remote sensing survey of the Hafit tombs of the Batinah. Google Earth is used to map the location of every visible Hafit tomb, and any similar prehistoric funerary structures, first in six transects across the region, and then across the entirety of the Batinah. Ground-truthing fieldwork assessing the accuracy of the results of both surveys is also described. Finally, GIS analysis of the distribution of the Hafit and later prehistoric tomb datasets is carried out in order to characterise the occupation of the Batinah during the Hafit period. In Chapter 6 the detailed ground survey of three Batinah Hafit cemeteries is described: Halban, Wadi al-Hoqain and al-Hamid. Each Hafit tomb at the three sites is recorded as well as any later prehistoric funerary structures. The Hafit tombs at these three case study sites are remarkably preserved and may have been constructed in the latter part of the period. Chapter 7 addresses the problem of Hafit settlement, detailing the Desert Surface Survey — an attempt to locate and record such a site in the Batinah. A large number of ephemeral stone features were discovered and recorded at the Hafit cemetery of al-Buyraq, and although they could not be concretely ascribed to the period, the aceramic nature of the site and the small, undiagnostic lithic assemblage is consistent with a Hafit date.

Part III constitutes the discussion and conclusion of the thesis. Chapter 8 amalgamates all of the evidence and interpretation from Part II, discussing what the new data may reveal about Hafit society in the Batinah and the northern Oman Peninsula. The wider Hafit archaeological dataset and published opinion regarding Hafit society is woven into the discussion. The subsistence and lifestyle, economy and technology, and politics and ideology of Hafit society are considered. The chapter argues that nomadic pastoralism rather than sedentary agriculture was central to Hafit subsistence, and that in some areas this was supplemented with marine-based food resources. The population appears to have become more sedentary towards the end of the period. It is argued that copper was central to the Hafit economy and, especially on the Batinah, contributed to lively local exchange and international trade. New skills and specialisations emerged as the period progressed. The chapter asserts that politically the northern Oman Peninsula was divided into territories focused around major wadi systems in much of Oman and other water resources in the Batinah. Territoriality, rights and ownership of land and resources, was expressed through the construction of Hafit tombs in visible positions. The region as a whole is likely to have shared a common social structure and ideology, although with some local variation. Evidence for social change in Hafit society either towards or galvanising against stratification comes from Batinah funerary architecture. In Chapter 9 the wider geographical context to Hafit material culture is considered, examining the stone tomb phenomenon in Southwest Asia in the fourth and third millennia BC. The occurrence of megalithic tombs, burial cairns and tower tombs similar and contemporary to Hafit funerary structures in the Near and Middle East is described, and three case studies are examined from Yemen, Sinai and western Syria. It is concluded that Hafit tombs may be a local expression of a lifestyle and ideology common to the arid areas of Arabia and the southern Levant delineated by the distribution of similar funerary structures.

This thesis should significantly augment our understanding of late fourth and early third millennium BC society in the northern Oman Peninsula, as well as our knowledge of the archaeology of the Batinah region. Firstly the Hafit archaeological dataset and published opinion regarding the nature of Hafit society must be reviewed.

A glossary following the list of figures at the start of the thesis explains terminology or technical language that may be unfamiliar to the reader. Terms included in the glossary appear ***in bold*** *in the main body of the text. A separate 'Terminology' list provides explanation of capitalised terms used in the thesis.*

An approximate transliteration of Arabic placenames into Roman script in accordance with maps and road signs is followed, lacking diacritical marks; the original Arabic versions of placenames relevant specifically to the fieldwork or remote sensing research are provided at the end of the thesis (Appendix E).

BC and AD are used to specify dates accurately throughout; BP and BC cal. are used to denote uncalibrated and calibrated radiocarbon dates.

Part I

Literature Review

Chapter 1

The archaeology of the Hafit period

The aim of this chapter is to present and review the published archaeological evidence related to the Hafit period. Hafit settlement and funerary material remains will be comprehensively reviewed, facilitating the discussion of Hafit society later in the thesis.

1.1 The Hafit period

The Hafit period constitutes the first part of the Early Bronze Age of the northern Oman Peninsula; it is named after Jabal Hafit where Hafit tombs were first discovered (Glob 1959: 239). These monuments were originally thought to date to the late 2nd millennium BC after regional parallels were drawn with graves good from a later reuse of one of the tombs (Bibby 1970: 297–298). However, this was quickly revised when ceramic vessels from the tombs were identified as Mesopotamian pottery dating to the Jemdet Nasr period, attributing the tombs to the late fourth and early third millennium BC (Frifelt 1971; During-Caspers 1971). The tombs and the period in which they were built continued to be referred to as 'Jemdet Nasr', with Frifelt suggesting that the large and better constructed 'Beehive' tombs present at some sites filled the gap between this period and that of the Umm an-Nar type graves datable to the latter part of the third millennium BC (Frifelt 1975b: 392). The more neutral term 'Hafit period' was adopted following a meeting of archaeologists working in the region (Weisgerber 1981: note 3). A detailed architectural study of the Bronze Age tombs of the region concluded that there was relatively little substantive difference between 'Hafit tombs' and 'Beehive tombs' (Vogt 1985b), while a reassessment of the pottery recovered from the tombs demonstrated that parallels for the ceramics from Mesopotamian and Iranian sites actually range in date from the Jemdet Nasr to the Early Dynastic III period, removing the gap that existed between the Hafit and Umm an-Nar periods which could now be dated from the late fourth to the mid third millennium and from the middle to the end of the third millennium BC (Potts 1986: 132–134).

Cleuziou, amongst others, sees the Hafit and Umm an-Nar periods as mere phases of the Early Bronze Age, a period of cultural continuity without any major break until its end in the very early second millennium BC, with the major social and economic changes occurring at its onset at the end of the fourth millennium BC (2007b: 211–212; 2002b: 191–192; 1997: 389–390). Others, the present author included, see the Hafit and Umm an-Nar as separate periods with a transitional phase between the two (Potts 2012). This is mainly reflected in the funerary architecture with a small but significant number of examples from across the region exhibiting architectural traits diagnostic of both periods (see 1.1.2 below), in one case these qualitative observations are supported by a radiocarbon chronology (Williams and Gregoricka 2013).

The absolute chronology of the period is the subject of some debate. The start is usually placed at 3,200 BC to correspond with the Jemdet Nasr period because of the pottery finds, although this Mesopotamian chronology is now itself outdated (Figure 1.1)). Mesopotamian pottery is not found in all Hafit tombs, and so the type could well pre-date the Jemdet-Nasr period; this uncertainty is compounded by the fact that relatively little is known about the mid-fourth millennium BC occupation of the region (Uerpmann 2003). The Hafit period ends with the onset of the Umm an-Nar period, but there is relatively little data available to define the start of this later period or that of the suggested transition phase. There is considerable variation in the precise date ranges provided for the Hafit period in the current literature (Thornton et al. 2016: 3, table 1.1; Cleuziou, Vogt, and Méry 2011: iii, 13; Potts 2001: 37), but 3,200–2,500 BC is a reasonable summary range for the purposes of this thesis that would include the transition phase with the following Umm an-Nar period.

The chronological difficulties make defining the 'Hafit' more broadly also problematic. The vast majority of the archaeological evidence for the period consists of the funerary remain, and so the tombs make up a large part of what the Hafit is defined by. They certainly make up the clearest element of the Hafit material culture, as the period is virtually aceramic and other elements such as the lithics are poorly understood. Evidence for Hafit settlement is much harder to pin down, largely because of the period's chronological uncertainties.

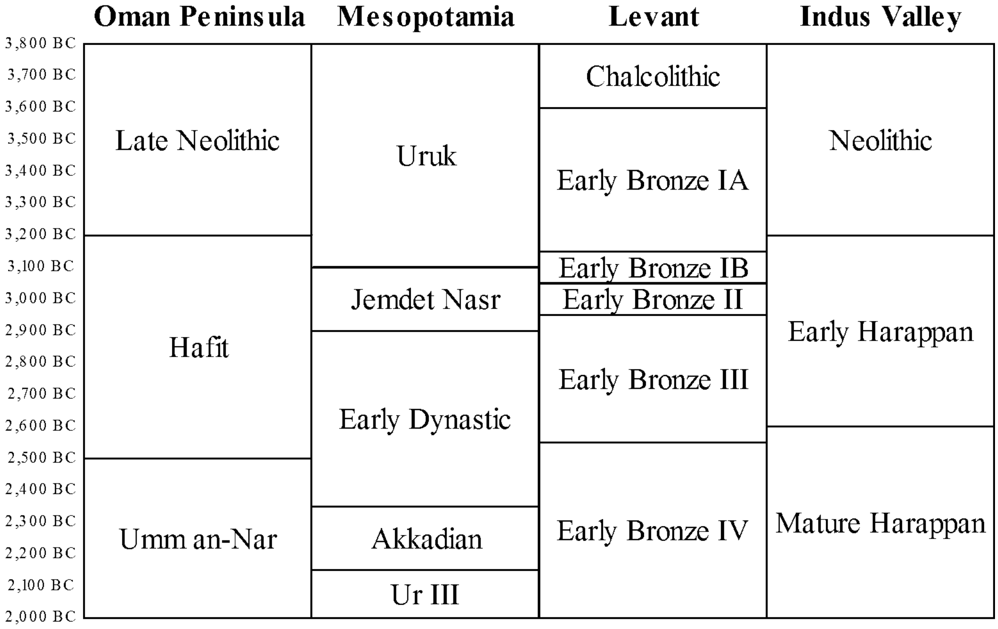


Figure 1.1: The Hafit period relative to other regional chronologies (Matthews 2013; Regev, De Miroschedji, Greenberg, et al. 2012; Coningham 2013)

1.1.1 Hafit settlements

While thousands of tombs cover much of the landscape of the northern Oman Peninsula, evidence for Hafit settlements is extremely scarce (see Appendix A.1). Claims have been made for Hafit occupation at only five sites: Ra's al-Hadd; al-Ayn; Hili; Bat and al-Khashbah (Figure 1.2). Each will be briefly examined, before the available dating evidence is reviewed.

Possible settlements

Ra's al-Hadd (HD-6) is a coastal Early Bronze Age settlement site that makes up part of the extensive archaeological remains located in the Ra's al-Hadd area. It was excavated by the Joint Hadd Project between 1996 and 2012; the excavators dated the major period of occupation at the site to between 3,100 and 2,700 BC (Hilbert and Azzara 2012: 7). Though some preliminary reports have emerged (Tosi et al. 2001; Cattani 2003; 1997), the site remains largely unpublished. Up to ten distinct structures have been excavated, consisting of single or multiple rectangular rooms of varying dimensions (Figure 1.3). The most common layout is of a long rectangular room with three smaller adjoining cells on each side, separated by a single row of stones several courses in height. Other structures are smaller, consisting of one to three rooms. One

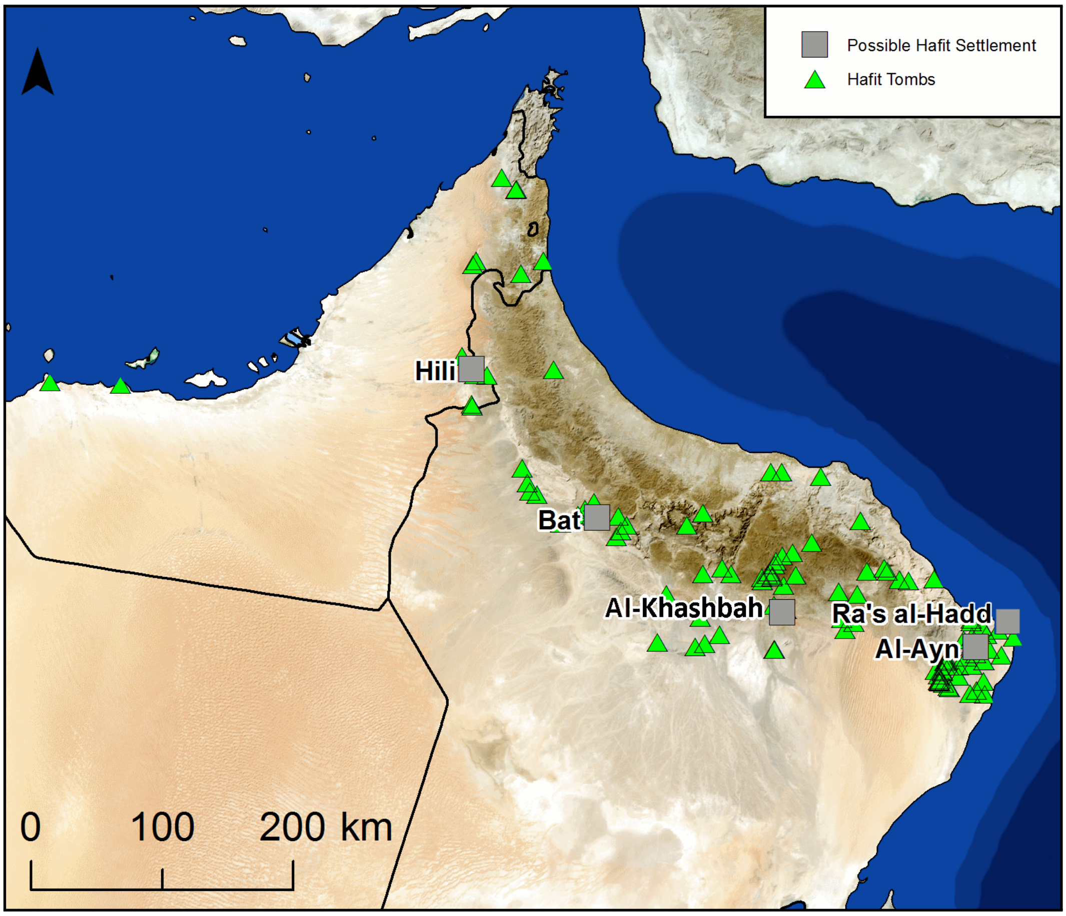


Figure 1.2: Map of possible Hafit settlement sites (see Appendix A.1)

building, located in the centre of the settlement, is much larger — consisting of sixteen rooms of varying size — and has a seemingly unplanned and organic layout (Azzara 2009: 2).

The walls consist of standardised mudbricks laid in courses in a stretcher pattern, bonded with a thin layer of mortar. These appear to have been occasionally restored or plugged with stones or clay. In most cases the floors of the structures consist of a surface of smoothed clay, though occasionally square stone tiles were discovered (Azzara 2009: 2). Hearths were excavated inside many of the buildings, while larger ovens were excavated outside a minority of the structures. Finds recovered from HD-6 suggest the domestic-based production of a number of commodities including shell rings and pendants, cold hammered copper objects, baskets and fishing equipment (Azzara 2009: 3). The site was virtually acceramic, with only four Mesopotamian potsherds being discovered during extensive excavations (Azzara 2009: 5). A substantial and diverse assemblage of locally manufactured lithics were also recovered from the site (Hilbert and Azzara 2012). Vast quantities of beads made from a wide range of materials — including steatite, stone, synthetic ensteatite, chlorite, jasper, shell and shark teeth

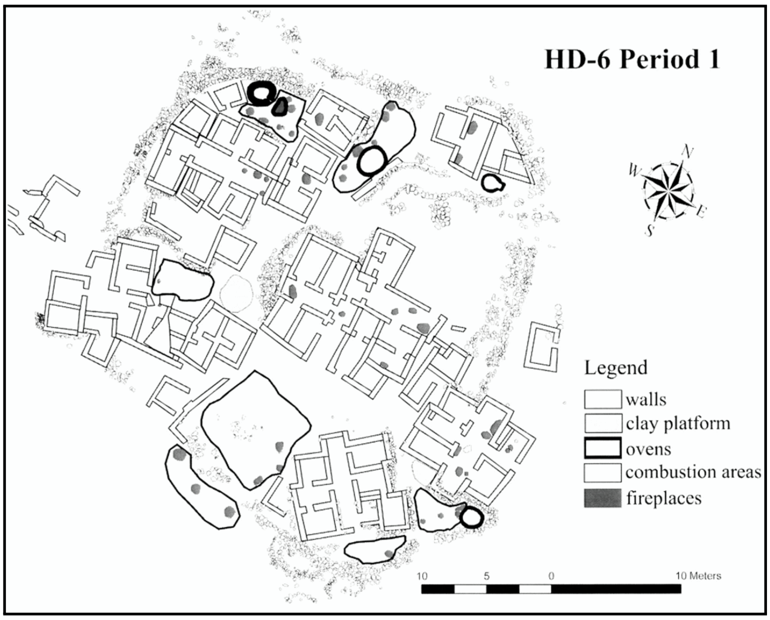


Figure 1.3: Plan of HD-6 during possible Hafit occupation (Azzara 2009: fig. 2)

(Azzara 2009) — suggest on-site manufacturing (Cleuziou and Tosi 2007: 94). Faunal evidence of marine exploitation was prolific including: oyster, mussel, crab and urchin shells; and fish, turtle, dolphin and bird bones (Cleuziou and Tosi 2007: 93). Evidence for terrestrial food include grinders, pestles and date stones (Azzara 2009: 6).

These substantial remains overlay evidence of an earlier period of occupation in one part of the site, consisting of post-holes, large pits and fireplaces cut into the sand (Azzara 2013: 13, 15), possibly indicating the presence of circular huts (Cleuziou and Tosi 2007: 93). Artefacts recovered from these early contexts include copper objects and steatite beads and suggest continuity in the material culture between the phases. The material remains from the most recent period of occupation consist of fifteen round huts built of large stones and are dated to some point after the Early Bronze Age (Azzara 2013: 16) — though very little has been published on this period of the site's history.

Al-Ayn (ALA-2) is situated near the eponymous village in Ja'alan, and was excavated by the Joint Hadd Project in 2004. A short, unreferenced description of the site is available (Blin 2007), and further detail has emerged from the secondary literature (Cleuziou 2009; Giraud 2009; Giraud and Cleuziou 2009), but the site is largely unpublished. It has been interpreted as the remains of scattered houses and palm tree gardens (Cleuziou 2009: 734). The excavated archaeology consists of a two-phased stone square structure (Figure 1.4), approximately 12x12m (Giraud and Cleuziou 2009: 173). The walls are ~0.7m wide, and built of unworked stone blocks, orthostat slabs are present on the internal side of the walls. These are built on a base of large stones laid directly onto the ground surface (Blin

2007: 249). The sediment around the walls suggests that they acted as a base for further mudbrick courses (Giraud and Cleuziou 2009: 173). No evidence of internal divisions is apparent, but there was a hearth in the centre of the floor and a round stone structure in the northwest corner (Blin 2007: 249). Postholes suggest that the structure could have been partially covered by a light roof; two smaller hearths were discovered outside the building (Giraud and Cleuziou 2009: 173).

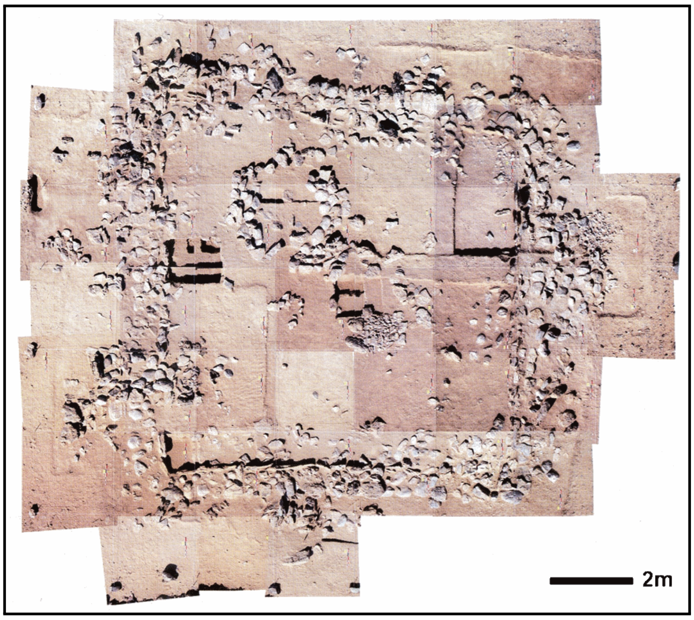


Figure 1.4: Photomosaic of excavated structure at ALA-2 (Blin 2007: fig. 266)

The stratigraphy consists of only two phases — the more complete later structure was built on the ruins of an earlier building with a similar design; the earlier phase produced two sherds of red coated pottery (Giraud and Cleuziou 2009: 173, 176). Other finds include flint flakes, shells, copper fragments, land-mammal bones and the charred remains of two date stones (Blin 2007: 250).

Hili 8 is a large site located near the Hili oasis of al-Ain, excavated by the French Archaeological Mission in Abu Dhabi over eight seasons. While the site is not fully published, the preliminary reports are fairly comprehensive (Cleuziou 1989a; 1982; 1980; 1979; Cleuziou, Pottier, et al. 1977). For a period of several decades it was considered to be the only known Hafit settlement (Potts 1990b: 78). The Hafit remains underlay an Umm an-Nar round-tower, one of several at a site that also boasts a multitude of contemporary tombs (Cleuziou, Vogt, and Méry 2011).

There are three phases of occupation, and it is argued that the Hafit period corresponds to Phase I (Cleuziou 1989b). The Phase I remains include a roughly square fortress (Building III), two outbuildings on the eastern side (Building V & VI), and a series of ditches partially encircling these structures (Figure 1.5).

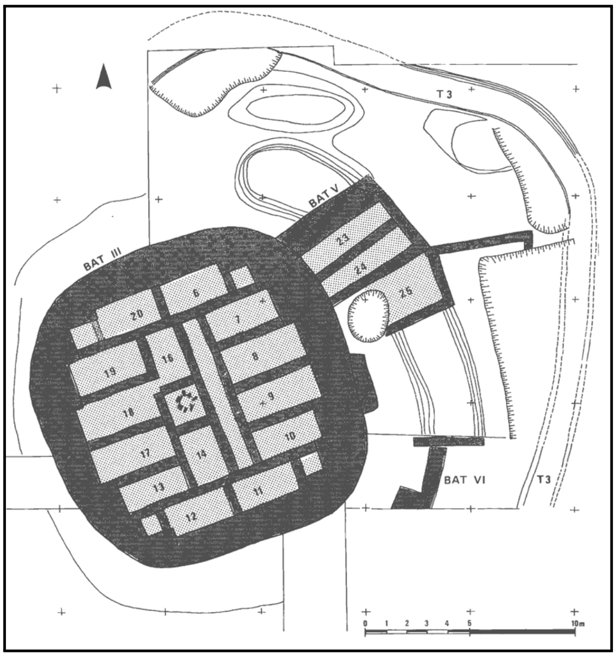


Figure 1.5: Plan of possible Hafit phase at Hili 8 (Cleuziou 1989a: plate 12)

Building III is a mudbrick tower; it is a rounded square, each side approximately 16 metres long. The basic structure is built of uniform mudbricks (45x50x8cm). The structure has a thick outer wall consisting of three rows of mudbrick and mortar (Cleuziou 1989a: 63). The interior is split into nineteen rectangular compartments by walls of a single row of mudbrick. These spaces were filled with a packing of sand and gravel, forming a solid base — possibly to support further buildings on top, to assist in the construction process or for perceived structural reasons. The structure has a well at its centre. It was dug down to four meters and was stone-lined (Cleuziou 1989a: 63–64). Building V, abutting the tower to the east, was first described as a grain silo (Cleuziou 1982: 17), but more recently it has been reinterpreted as the remains of a *madbassa* — a device for collecting syrup from dates compressed under their own weight (Cleuziou 2007a). It is built in a similar fashion to Building III, with identical materials. Building VI, similar to Building V, was built in a slightly later phase and was damaged by later construction (Cleuziou 1989a: 66).

Phase I, which the excavators associate with the Hafit period, was rich in finds. Stone artefacts, including hammer and grinding stones of metamorphic rock, are common. Beads are much rarer, but a small number of steatite beads were recovered as well as a large barrel-shaped quartzite bead. Evidence for the smelting and working of copper is present, including slag, pins and a small knife blade. Impressions found in clay suggest that baskets and mats were manufactured or used at the site; shells were also recovered, some of which were used to make beads and rings (Cleuziou 1989a: 73–74). Pottery is very rare; ~100 sherds from ~20 vessels were recovered — ~0.4% of the site's pottery (Cleuziou 1989b: 49). The sherds are from large storage vessels and small bowls and jars, the pastes are well-fired and light brown, green or red, some are coated in a red wash, and a few are painted with black patterns. Some of the pottery was imported, mostly from Mesopotamia, but also from southeastern Iran (Potts 1990b: 80; Cleuziou 1989b: 49–52).

Hili 8's palaeoenvironmental remains, the majority of which came from the middle of Phase I (Cleuziou 1989a: 79), include wheat, barley, oats, date, melon and jujube fruit (Cleuziou and Costantini 1980), sorghum was also initially identified, though this is now known to have been a mistake (Rowley-Conway et al. 1999; 1997). Phase I's archaeozoological remains include caprids, bovids, equids and camel, as well as fragments of bird bone and ostrich shell (Cleuziou 1989a: 81).

Kasr al-Khafaji (Bat 1146) is another Umm an-Nar site that may also have been occupied during the Hafit Period. The site is only recently excavated, and as well as detailed preliminary reports (Thornton et al. 2013; Possehl et al. 2010; 2009; 2008), has just been published (Thornton et al. 2016). 1146 is a typical round tower dating to the Umm an-Nar period (Figure 1.6). However, the excavators suggest that it was built on the remains of a Hafit village (Thornton et al. 2016: 39–46; Thornton et al. 2013: 257).

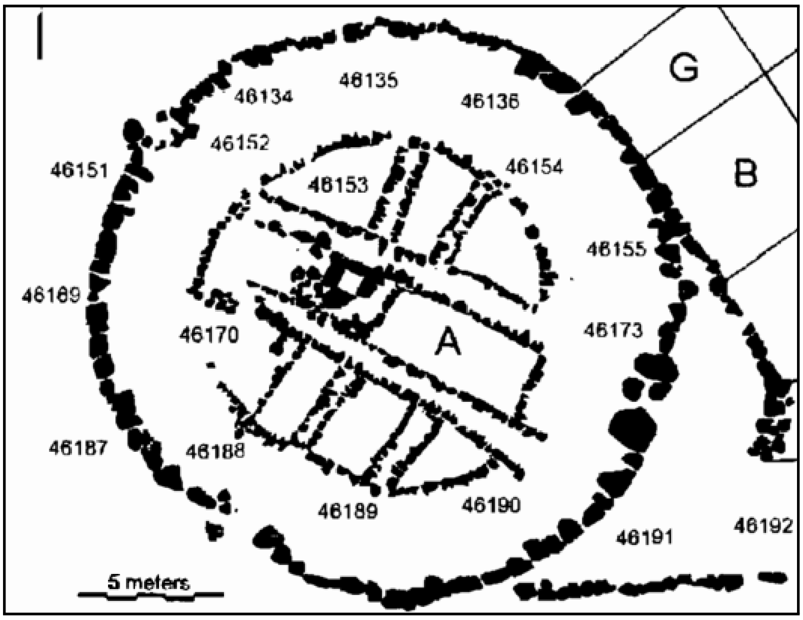


Figure 1.6: Plan of tower 1146 at Bat — trench A contains the remains of a possible Hafit village (Possehl et al. 2009: fig. 7)

One of the larger tower basement compartments was excavated down to the natural. Above it were the remains of two structures and a layer of 'loamy sediment' argued to be the remains of irrigated fields (Desruelles et al. 2016; Thornton et al. 2016: 46; Possehl et al. 2010: 7). The two structures consist of a number of stone and mudbrick walls. One side of the trench yielded the remains of a stone wall corner; abutting this on the other side were a number of walls constructed out of dark mudbrick supported by at least one layer of stone slabs. Between two and six courses of mudbricks survived, reasonably uniform in proportion (~45x30x10cm) and bonded by thick layers of white ashy mortar (Thornton et al. 2016: 44; Possehl et al. 2009: 7). The interior of these structures was later filled with smaller, lighter mud bricks and thick mortar to form a flat platform, the foundation for the Umm an-Nar tower (Thornton et al. 2016: 46; Thornton et al. 2013: 257).

These layers were relatively sterile, but finds included several lithic blade fragments, one piece of copper slag, one piece of copper ore, charcoal, two quern stones and a grindstone (Thornton et al. 2016: 44; Possehl et al. 2009: 7).

Matariya (Bat 1147) is another Bat site argued to have been occupied during the Hafit period (Thornton et al. 2016; Possehl et al. 2011; 2010; 2009; 2008). The stratigraphy is very complicated, exasperated by the natural hillock on which it sits. There were a number of phases of construction (Thornton et al. 2016: 79–81) — the earlier of which are claimed to date to the Hafit period (Figure 1.7).

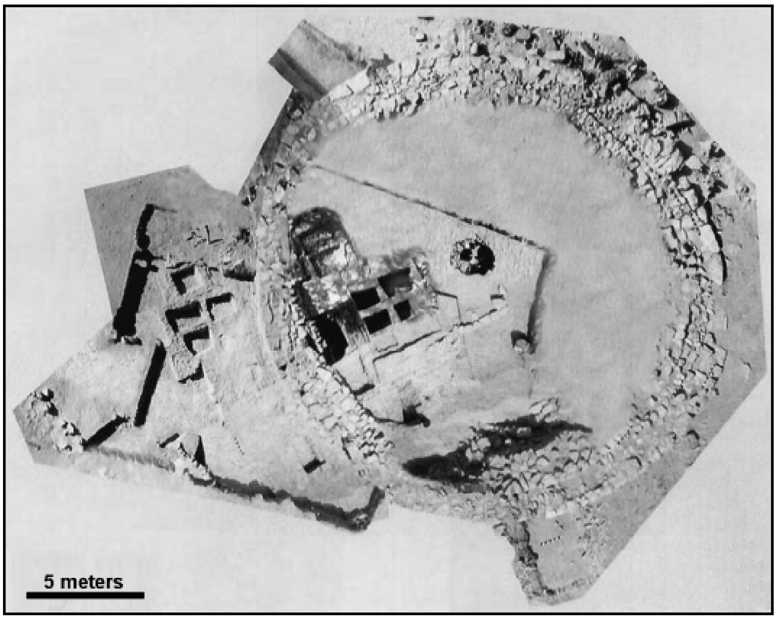


Figure 1.7: Photo plan of tower 1147 at Bat — the compartments have yielded possible Hafit dating evidence (Possehl et al. 2009: fig. 40)

Firstly, a ~20x25m platform was built, comprising of compartments of mudbrick walls, filled with rubble and capped with mudbrick. Following this a roughly circular retaining wall, of stone masonry of varying quality, was built around it (Possehl et al. 2011: 6; 2009: 23). A 1–3m extension was added at the southern end of the platform (Possehl et al. 2011: 5), and a stone-lined well was dug in the middle of this upper level. This was ringed by an outer wall to form a Umm an-Nar round-tower, and was reinforced with a second phase to thicken it, and finally a ring wall was built around the structure (Possehl et al. 2011: 5–6; 2009: 23–25). The excavators suggest that the mudbrick platform and the well date to the late Hafit period (Possehl et al. 2011: 5), and that the latter masonry additions are Umm an-Nar (Possehl et al. 2011: 6). This is supported by the ceramics finds: three sherds of Early Dynastic/Jemdet Nasr pottery in the earlier layers (Thornton et al. 2016: 189; Possehl et al. 2009: 12, fig. 53), and early Umm an-Nar and Harappan sherds in the later strata (Possehl et al. 2010: 19). Relatively few finds were recovered during the excavation of Matariya and the majority were from much later layers. Faunal remains include caprid bones, cuttlefish remains, shell beads and unworked shells. A broken pestle was recovered from a compartment, as well as small copper artefacts including prills, rings, pins and chisels (Possehl et al. 2009: 12–14).

al-Khashbah is unlike the other sites as the excavators interpret it as an industrial site that was occupied only occasionally by nomads during the Hafit period (Schmidt and Döpper 2017: 225). Investigations are still ongoing at the site and so relatively little has been published so far. Building V, dated to the late fourth millennium by radiocarbon analysis of several charcoal samples, consists of a 25m diameter round stone wall as well as a series of smaller walls that do not run parallel, together forming a somewhat enigmatic structure (Schmidt and Döpper 2017: 5, figs 8–9). Surface and stratified finds include large volumes of copper slag, prills and furnace fragments but no pottery (Schmidt and Döpper 2017: 5). There are other similar stone structures, suspected to be of a similar date in other parts of the site (Schmidt and Döpper 2017: 5, fig. 10). A series of ditches and mudbrick structures have been dated to c. 2,800 BC, towards the end of the Hafit period, through the radiocarbon dating of a number of charcoal samples; finds include hammerstones, some copper artefacts, but no pottery (Schmidt and Döpper 2017: 5, 7, fig. 14).

Dating the settlements

These six settlements form a small but highly significant collection of sites from across the northern Oman Peninsula, that may shed considerable light on Hafit society. Unfortunately there are issues with dating at many of these sites that in some cases cast doubt on their Hafit period occupation. Only the Bat sites have been fully published, although the Hili preliminary reports are fairly comprehensive, while work at al-Khashbah is ongoing and at a relatively early stage. It is possible that more complete publication would bolster the case for Hafit occupation in some cases. The dating evidence from each site will be considered, before some general points are made regarding the use of radiocarbon dating and the analysis of ceramics at these possible Hafit settlements.

Al-Khashbah is well dated, considering that research is still at an early stage, through both radiocarbon analysis and the material assemblage. Six charcoal samples from different parts of Building V date the structure to the end of the fourth millennium BC, and a further ten from different parts of the building and ditches of Building I date it to around c. 2,800 cal. BC, while the lack of pottery at either is consistent with what would be expected from this period (Schmidt and Döpper 2017: 5, 7, figs 9, 14).

HD-6 is another of the better dated sites. The first ephemeral stage of occupation is dated by a single radiocarbon date of 3,090–2,870 cal. BC, around the middle of the Hafit period, and three radiocarbon dates place the second phase between 2,910 and 2,570 cal. BC, towards the end of the period (Azzara 2013: figure 3). The most recent phase has not yet been dated (Azzara 2013: note 1). Samples were taken from a combination of hearth charcoal and faunal remains, but no further details have been provided (Azzara 2013: fig. 3). Secondary publications reveal more about the ceramics from the site: "only four potsherds of Mesopotamian ware and one fragment of possibly later 'black on red' " have been recovered (Azzara 2009: 5). The sherds are not illustrated, and it is unclear why the black-on-red sherd is thought to be later. An examination of the lithics resulted in the suggestion that some tools had parallels with the assemblage from RJ-2 — a site dating to the Umm an-Nar period (Hilbert and Azzara 2012: 17).

ALA-2 has been radiocarbon dated, however the results were pending in 2009 and are still yet to be published (Cleuziou 2009: 734). The pottery assemblage consists of "several fragments of a reddish coated pottery" that may be dated from the third millennium BC (Blin 2007: 249; Giraud and Cleuziou 2009: 176), they are not illustrated. The fact that the site's position corresponds to the calculated centre-of-gravity of a large group of Hafit tombs, has been presented as evidence to support an early third millennium date (Giraud 2009: 747; Cleuziou 2009: 734); this logic is fundamentally flawed — dating by association across such a large area is highly questionable. Furthermore, Umm an-

Nar tombs are found in closer proximity to the site (Cleuziou 2009), and these are well known for their proximity to contemporary settlements (Deadman 2012b). Cleuziou also suggests that similarities between the flint industry of ALA-2 and HD-6 supports the case for a Hafit date for the settlement (2009: 734); however, a thorough analysis of the lithics of HD-6 only drew parallels with the Umm an-Nar assemblage of RJ-2 (Hilbert and Azzara 2012: 17). Finally, Giraud and Cleuziou suggest that "the presence of *Engina mendicaria* (a sea snail), which disappears from the archaeological assemblages of the second part of the third millennium BC, is a good although not fully decisive indicator of an early third-millennium date" (2009: note 9). While the hypothesis is interesting and merits further research, it is also entirely unproven, and does not support the case for Hafit occupation.

The dating of Hili-8 is contentious, despite the fact that for a long time it was considered to be the sole example of a Hafit settlement in the Oman Peninsula (Potts 1990b: 84). Charcoal was recovered from two hearths contemporary with the construction of the first large mudbrick tower and was successfully radiocarbon dated to 3,110 $\pm$ 190 cal. BC (Cleuziou 1979: 32). However, Potts has suggested that this date is likely to be inaccurate (1997). Cleuziou suggests that this dating evidence is supported by the recovery of ~100 sherds of imported pottery which he assigns to the late Jemdet Nasr or Early Dynastic I period in Mesopotamia (1989b: 49–52). However, the recovery of sherds of black-on-red ware — from southeastern Iran, dating to 2,800–2,600 BC at the earliest — brings his dating of this ceramic assemblage into question (Cleuziou 1989b: 52; Cleuziou and Tosi 1989: 33–35). The distribution of the pottery throughout the strata is not described, it may be possible that one or more pits dug in a later phase was missed during the excavation, especially as some phase I sherds were recovered from later layers (Cleuziou 1989b: note 1). Further dating evidence for Hili 8 has emerged recently, with domestic architecture from the beginning of phase II integrating Umm an-Nar tomb facing stones (Méry 2013: para. 4), presumably these were taken from older tombs (dating to phase I) which suggests that this early phase does in fact date to the early Umm an-Nar period.

The 'Hafit village' under the tower of Kasr al-Khafaji (Bat 1146) has been radiocarbon dated by two samples producing a range of dates from 3,040 to 2,480 cal. BC (Thornton et al. 2016: table IV.1; Possehl et al. 2009: table 1), the mid-Hafit to early Umm an-Nar period. The dated samples consist of loose charcoal recovered from a stone wall, and another piece from mudbrick mortar in a different structure (Thornton et al. 2016: 39, 44; Thornton et al. 2013: 257). The excavators argue that the lack of ceramics in these older strata in comparison to the pottery-rich Umm an-Nar layers is consistent with a Hafit date (Possehl et al. 2009: 8; Thornton et al. 2013: 257).

The tower structure of Matariya (Bat 1147) has been dated by a tiny assemblage of ceramics and several radiocarbon dates. Two charcoal samples were dated to between 2,890 and 2,620 cal. BC, the late Hafit period. One was taken from between a mudbrick compartment and the retaining wall, and the second from one of the compartments (Thornton et al. 2016: 79, 81, table IV.1; Possehl et al. 2009: 24–25). Two pieces of pottery identified as Jemdet Nasr/Early Dynastic imports were also recovered (Possehl et al. 2010: fig. 34). One of these sherds was recovered at the base of a break in the retaining wall. A third, while similar, is described as a local imitation and was recovered from the fill of one of the mudbrick compartments (Possehl et al. 2009: 22, fig. 53).

Radiocarbon dating was employed at all of these sites, but relatively little information about the samples is provided, making it very difficult to assess their reliability (Table 1.1).

Table 1.1: Radiocarbon date samples from possible Hafit settlement sites

Site	Identifier	Sample	Uncal. BP	BC cal. – OxCal	Reference
HD-6	LTL5047A	charcoal	4316 ± 45	3090–2870 (95%)	(Azzara 2013: figure 3)
	LTL8081A	hearth charcoal	4205 ± 45	2910–2630 (95%)	*Ibid.*
	LTL5135A	camel tooth	4160 ± 50	2890–2580 (95%)	*Ibid.*
	LTL8082A	hearth charcoal	4152 ± 45	2880–2580 (95%)	*Ibid.*
	LTL8083A	hearth charcoal	4132 ± 50	2880–2570 (95%)	*Ibid.*
Hili 8	MC-2266	hearth charcoal	4440 ± 100	3370–2892 (95%)	(Cleuziou 1979: 32, table 1)
	MC-2267	hearth charcoal	4400 ± 100	3366–2876 (95%)	*Ibid.*
K. al-Khafaji	beta 260662	charcoal	4070 ± 40	2859–2486 (95%)	(Possehl et al. 2009: table 1; Thornton et al. 2013: 257)
	beta 260661	charcoal	4330 ± 40	3084–2887 (95%)	*Ibid.*
Matariya	beta 260667	charcoal	4190 ± 40	2895–2634 (95%)	(Possehl et al. 2009: 24, table 1)
	beta 260665	charcoal	4140 ± 40	2876–2585 (95%)	(Possehl et al. 2009: 23, table 1)
	beta 244213	charcoal	4240 ± 40	2920–2678 (95%)	(Possehl et al. 2009: 24, table 1)
Khashbah BV	24458	charcoal	4464 ± 24	3333–3026 (95%)	(Schmidt and Döpper 2017: fig. 9)
	24459	charcoal	4446 ± 24	3330–2946 (95%)	*Ibid.*
	27882	charcoal	4500 ± 28	3346–3097 (95%)	*Ibid.*
	27884	charcoal	4498 ± 30	3347–3096 (95%)	*Ibid.*
	27885	charcoal	4513 ± 31	3353–3099 (95%)	*Ibid.*
	27886	charcoal	4538 ± 30	3363–3104 (95%)	*Ibid.*
Khashbah BI	27867	charcoal	4350 ± 29	3079–2902 (95%)	(Schmidt and Döpper 2017: fig. 14)
	27868	charcoal	4115 ± 27	2863–2578 (95%)	*Ibid.*
	27870	charcoal	4086 ± 33	2860–2495 (95%)	*Ibid.*
	27871	charcoal	4304 ± 28	3010–2883 (95%)	*Ibid.*
	27872	charcoal	4141 ± 26	2872–2625 (95%)	*Ibid.*
	27873	charcoal	4123 ± 26	2865–2581 (95%)	*Ibid.*
	27874	charcoal	4145 ± 27	2873–2627 (95%)	*Ibid.*
	27875	charcoal	4057 ± 26	2834–2488 (95%)	*Ibid.*
	27876	charcoal	4195 ± 27	2890–2679 (95%)	*Ibid.*
	27877	charcoal	4180 ± 26	2884–2671 (95%)	*Ibid.*

Assessing the reliability of radiocarbon dates is not a simple task, because no systematic procedure has been adopted by the archaeological community (Pettitt et al. 2003: 1685). However, more than forty years ago Waterbolk noted some key issues in assessing the reliability of dates that fall under the remit of the archaeologist rather than the laboratory, including ascertaining the association between a dated sample and the archaeology that it is intended to date, and the difference in age between a sample and the date of its deposition (1971). In this vein, Pettitt and colleagues implemented a set of rigorous criteria to quantify the reliability of radiocarbon dates. There is too little data to apply these criteria to the Hafit settlement samples, but the authors raise some highly relevant general concerns including: the importance of identifying wood charcoal to a genus; eliminating the 'old age' effect in wood; failure to identify the sample material; the stratigraphic mobility of samples; direct association of the sample with human activity; and the quantity of dates for archaeological horizons (Pettitt et al. 2003). In no case is detailed information about radiocarbon samples and the rigorous methods employed presented to inspire the highest possible level of confidence in the dates(e.g. Asscher et al. 2015: 81–83; Boaretto 2015; Regev, De Miroschedji, and Boaretto 2012).

The most reliable dates come from Hili 8, HD-6 and al-Khashbah. At al-Khashbah and HD-6 the material is identified and a large number of samples were dated, and at the latter multiple materials were dated all from a secure anthropogenic context. At Hili 8 the samples are identified; the charcoal was taken from a hearth; two separate samples were taken producing identical dates; and the hearths were directly under mudbrick walls that showed signs of burning — ensuring that the construction of the building itself was being dated (Cleuziou 1989a: 64). However, the accuracy of these dates have been questioned specifically by Potts. He suggests that the dates are "anomalously early" in comparison with the other Hili 8 dates (2,484 to 1,736 cal. BC); and radiocarbon dates from other Umm an-Nar round towers (2558 to 1938 cal. BC). He suggests that the dates could be the result of the 'old wood effect' (Potts 1997: 66–67), that the date of "its formation pre-dated the archaeological event of interest" (Aitken 1990: 87). Potts points out without these dates the Hili 8 sequence fits perfectly with the dating of other round towers in the region, and better fits the archaeology of the area — as the nearest Hafit tombs are several kilometers away from their suggested associated settlement (1997: 67). The recent discovery of Umm an-Nar tomb facing stones (presumably dating from phase I) integrated into domestic architecture early in phase II raises further concerns about the date of the site (Méry 2013: para. 4).

There are also some issues with the dating of the sites' imported ceramic assemblages. Pottery has been recovered in small quantities at four of the five sites (Table 1.2); the ceramics are only illustrated at Matariya and Hili 8, and in both cases they are dated to the Jemdet Nasr/Early Dynastic period.

Hili 8 has produced by far the largest assemblage of pottery from its 'Hafit' layers — ~100 sherds from ~20 vessels (Cleuziou 1989b: 49). Despite his own uncertainties, Cleuziou sees the clearest parallels in this assemblage with Jemdet Nasr pottery in Mesopotamia (1989b: 51). This is surprising given that it includes none of the Jemdet Nasr pottery commonly recovered from Hafit tombs (see Grave goods in 1.1.2). The most common ware is a "light brown paste, sometimes with a grey core, with some black

Table 1.2: Summary of the ceramic evidence from possible Hafit settlement sites

Site	Ceramics	Illustration	Date	Reference
HD-6	4 sherds of 'Mesopotamian ware'; one of black-on-red	None	Not dated	(Azzara 2009: 5)
ALA-2	reddish coated pottery	None	'From the third m. BC'	(Giraud and Cleuziou 2009: 176)
Hili 8	~100 sherds, various wares	Some drawn	Jemdet Nasr	(Cleuziou 1989a: 74–75)
Matariya	three rim sherds	Yes	J. Nasr to E. Dynastic	(Thornton et al. 2016: fig. 9.1; Possehl et al. 2009: 22, fig. 53; 2010: fig. 34)
Kasr al-Khafaji	No ceramics found			
Al-Khashbah	No ceramics found			

inclusions and a buff hand-smoothed surface" (Cleuziou 1989b: 49). The distinctive Jemdet Nasr ware found in Hafit tombs is a red/brown ware, with plum/red/black paint and a cream slip (Potts 1986: figs 1–2). Moreover, there appears to be very little similarity in the forms seen in the two assemblages. There are clear similarities in form and paste between the Hili 8 assemblage and the band and bevel rimmed jars, and bowls recovered from the settlement of Umm an-Nar which date to the early Umm an-Nar period (Frifelt 1995: 123–146). An early Umm an-Nar date also better matches the Hili 8 Iranian black-on-red ceramics, which Cleuziou himself parallels with Shahr-i Sokhta ceramics that date to 2800–2600 BC at the very earliest (1989b: 52). Potts asserts that the ceramic assemblage places Hili 8 at or after the start of the Umm an-Nar period (1986: 132); in a personal communication to the present author, he suggested that apart from the later Early Dynastic Mesopotamian ceramics the pottery was 'classic Umm an-Nar'.

At Matariya three sherds have been recovered. One shares similarities with the Hili 8 ceramics — a light brown paste, a grey core, sand/grit inclusions and a similar form of rim (Possehl et al. 2010: fig. 34; Cleuziou 1989b: 49). While another resembles the classic Jemdet Nasr/Early Dynastic I vessels recovered from Hafit tombs, including a red/brown paste, a grit temper and evidence of cream/buff slip and red paint (Thornton et al. 2016: fig. 9.1; Possehl et al. 2010: fig. 34; Potts 1986: figs 1–2). The third is similar, but with a greenish buff fabric (Thornton et al. 2016: fig. 9.1). However, the hills surrounding the site are lined with Hafit tombs, where such pottery may have originated (Frifelt 1975a), or it may date to a later phase of the Early Dynastic period (Potts 1986).

The ceramics from the other sites have not been illustrated or described (Azzara 2009; Blin 2007).

There are issues with both the radiocarbon dates and the interpretation of the ceramic evidence at a number of these settlements. In some cases more evidence needs to be published to date them definitively. While there is good evidence that al-Khashbah was occupied during the middle of the Hafit period, it is likely that some of the others were occupied towards the end of the period — especially Bat and Ra's al-Hadd — while at the remainder occupation is more likely to have begun during the early Umm an-Nar period — al-Ayn and Hili 8.

1.1.2 Hafit tombs

Hafit tombs are found in great numbers across much of the northern Oman Peninsula — more than one hundred Hafit funerary sites are known (see Appendix A.1). The only published estimate suggests that there may be many more than 100,000 surviving Hafit tombs distributed across the region (Cleuziou and Tosi 2007: 122).

A significant number of the tombs have been excavated — almost sixty at Jabal Hafit (Potts 1986), and at least thirty others at sites across the region (Table 1.3).

Table 1.3: The number of Hafit tombs excavated by site

Site	Excavators	No.	Reference
Al-Ayn	University of Tübingen	2	(Döpper and Schmidt 2014; Schmidt 2011; 2010)
Bat	Danish Team	2	(Frifelt 1975a)
Bisya	Al Hajar Project	1	(Orchard and Orchard 2007)
Buraimi	Amateurs	2	(During-Caspers 1971)
Ghoryeen	Sultan Qaboos University	1	(al-Jahwari 2010)
Hijar	Danish Team	1	(Frifelt 1975a)
Khubayb	SoBO American Team	6	(Williams and Gregoricka 2013)
Khutma	SoBO American Team	1	(Williams and Gregoricka 2013)
Maysar	Deutsches Bergbau Museum	4	(Weisgerber 1981; 1980)
Ra's al-Hadd	Joint Hadd Project	5	(Salvatori 2001)
Ra's al-Jinz	Joint Hadd Project	2	(Santini 1987a)
Salut	Italian Mission to Oman	2	(Degli Eposti and Phillips 2012)
Shenah	SQU	8	(al-Belushi and ElMahi 2009)
Shir	Deutsches Bergbau Museum	3	(Yule and Weisgerber 1998)
Tawi Silaim	British Expedition	4	(de Cardi, Bell, et al. 1979; de Cardi, Doe, and Roskams 1977)
Jabal Dhanna	Dept of Antiquites, al-Ain	1	(Vogt, Gockel, et al. 1989)
Jabal Hafit	Danish Team	25	(Frifelt 1971)
	French Expedition	6	(Cleuziou, Vogt, and Méry 2011; Cleuziou, Pottier, et al. 1977)
	Iraqi/Emirati Team	27	(Ministry of Information 1975)*
Mazyad	Danish Team	6	(Frifelt 1975a)
Qarn Bint Sa'ud	Danish Team	1	(Frifelt 1971)
	Dept of Antiquites, al-Ain	10	(al-Tikriti 1982)**
Ra's al-Aysh	Dept of Antiquites, al-Ain	1	(Vogt, Gockel, et al. 1989)
Jabal al-Emalah	University of Sydney	3	(Potts 2012; Benton and Potts 1994)
Jabal Buhais	Sharjah Museum	~5	(Jasim 2012; 2003; Uerpmann et al. 2006)
Kalba	Eddisford and Phillips	3	(Eddisford and Phillips 2009)

*not seen by the author, cited in (Cleuziou, Pottier, et al. 1977)
**not seen by the author, cited in (Vogt 1985b)

However, while the Hafit tomb phenomenon is well known, the structures themselves extremely common, and while a significant number have been excavated, no effort has yet been made to review the data across the disjointed literature to produce a clear and thorough summary.

Hafit tombs are collective burial structures built of unworked stone (Potts 2009: 33). They show considerable architectural variation, but in general they are circular and are usually between five and seven metres in diameter. They consist of one or more courses, or rings, of corbelled drystone masonry walls, constructed to form a rough dome over a single round burial chamber (Potts 1993b: 183). They have a single small entrance often pointing east (Deadman 2014) in some, but not all areas (Belmonte and Gonzalez-Garcia 2014). They are built of the locally available stone. Their domed shape accounts for the term 'beehive tombs' that has commonly been used to describe them (Frifelt 1975a), while their frequent severe state of collapse explains the other frequently used name of 'Hafit cairns' (Cleuziou and Tosi 2007: 108). The contrast between examples of these two 'types' culminated in the theory of two parallel Hafit burial traditions (Potts 1990b: 77), though in fact they are of the same architectural form (Vogt 1985b). They are located on ridges and low foothills — elevated ground that makes them highly visible features in the landscape (Deadman 2012a). Undisturbed structures have yielded small copper artefacts, beads in various forms and materials, and imported Mesopotamian pottery dating to the Jemdet Nasr period (Potts 1990b: 74). Three, four or even fewer individuals were usually interred (e.g. Williams and Gregoricka 2013), but in some examples this number is much larger (Potts 2001: 37).

This description follows the generally accepted model of Hafit tombs in the wider literature, but it belies the wide variation that is apparent in the excavated examples which is seldom discussed. This section seeks to go beyond this model by comprehensively summarising the Hafit tomb dataset as a whole including architecture, distribution, grave goods and human remains.

Architecture

Although some of the variation in Hafit tomb architecture may be attributed to differences in building material and structural preservation rather than construction or form (Vogt 1985b), they nonetheless show significant diversity. This will be demonstrated, discussing first the architecture of the 'standard' Hafit tombs, and then the more unusual examples that excavators have described as 'transitional' — i.e. sharing some characteristics with tombs from the Umm an-Nar period.

The complexity of 'standard' Hafit tombs varies markedly. It is unclear whether this is due to chronological development in style, differing material and human resources, multiple phases of use, other site formation processes, or a combination of some or all of these factors. At their simplest, Hafit tombs consist of a single round wall of rough masonry (Figure 1.8); K1A and K1B at Kalba were constructed using "angular stones from the adjacent hillside" (Eddisford and Phillips 2009: 111), and BHS 89 at Jabal Buhais consists of "multiple rows of heavy stones" (Jasim 2012: 127). These rough stone structures were simply corbelled to form small burial chambers, BHS 89 simply paved but without any apparent access at ground level, and the tombs at Kalba with entrances on the northwest side (Jasim 2012; Eddisford and Phillips 2009). The tombs excavated at HD-10 are very similar, although at least one appears to have been sealed shut with an additional inner wall, blocking a simple easterly entrance (Salvatori 2001).

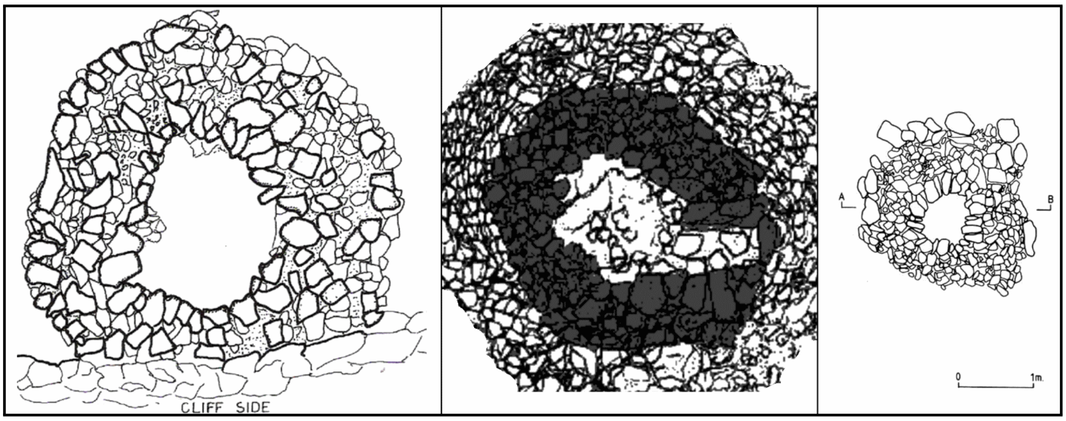


Figure 1.8: Scale plans of simple Hafit tombs: BHS 89, HD10-3.1 & K1A (altered after Jasim 2012: fig. 11; Salvatori 2001: fig. 2; Eddisford and Phillips 2009: fig. 3)

Slightly more complex Hafit tombs show multiple phases of construction. Cairn 4 at Tawi Silaim is similar in form, with a single walled corbelled structure built of unworked stone, surrounding a paved elliptical chamber accessed through a narrow entrance. However, extra effort appears to have been made to seal the structure: the doorway was blocked with two courses of flat stones and loose rubble, while additional courses of unfaced limestone blocks were added to the outside of the cairn, further inhibiting access and giving the structure its circular shape (de Cardi, Bell, et al. 1979). Tomb IV at Jabal al-Emalah is similar — a simple, single-walled, corbelled, elliptical chamber of unworked stone, but ringed by a large external wall, with the space between packed with stones (Figure 1.9). Interestingly, the chamber is located off-centre, in the southern portion of the enclosed area (Benton and Potts 1994).

Commonly, Hafit tombs are simpler in form than Tomb IV, lacking a ringwall, but are less crude in their construction (Figure 1.10). Only a short distance away from Cairn 4 at Tawi Silaim are Cairns 2 and 3 which are structurally identical to each other. Cairn 2 is circular in shape, measuring just under 4m in diameter, with a circular chamber measuring 2.5m. A clear entrance is visible facing east, blocked with rubble and sand. The walls of the tomb are built of laminated slabs of limestone masonry, sourced from the nearby hillside, and the floor of the chamber is paved with the same material, lying directly on the stony plain. Only a small number of courses survived — but they slope inwards, suggesting that the walls were corbelled (de Cardi, Bell, et al. 1979). A similar example, but better preserved, comes from al-Ayn. Tomb 7 is constructed of a single wall, but is preserved to a height of 2.9m with the ceiling of the tomb almost closed. At the entrance of the tomb the wall steps horizontally inwards, as well as corbelling vertically,

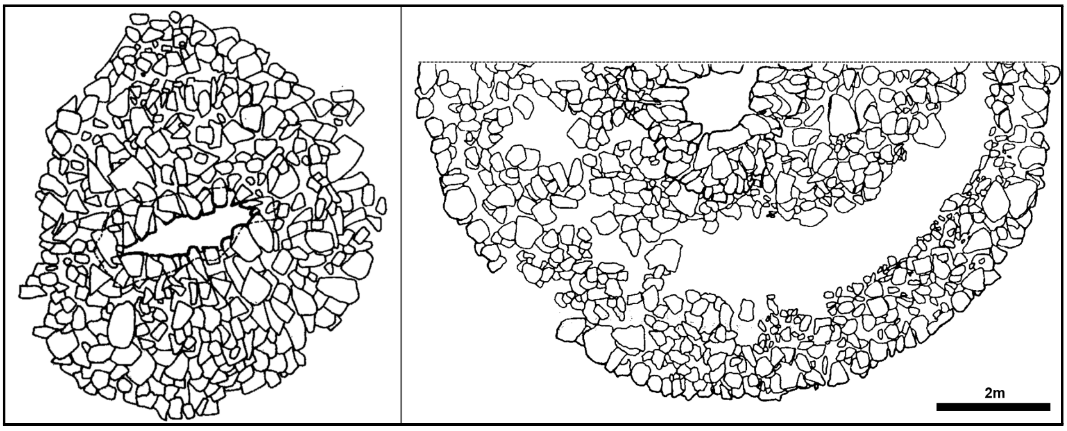


Figure 1.9: Scale plans of Hafit tombs: cairn 4 and tomb IV (altered after de Cardi, Bell, et al. 1979: fig. 5; Benton and Potts 1994: fig. 19)

producing a triangular entrance. The outer face of the wall is flush and regular, while the inner face inside the chamber is irregular with many gaps; the structure is built of flat slabs of sedimentary rock (Döpper and Schmidt 2014: 223; Schmidt 2011). ST2 at Shenah closely resembles this tomb, but its entrance has not survived (al-Belushi and ElMahi 2009: 34). However, less suitable material was also used to build very similar structures — Maysar 3:17 is constructed of round wadi cobbles carefully laid in regular courses to create a smooth outer wall face, while less care was taken with the inside facing (Weisgerber 1980: 91, fig. 53). Although plans have not yet been published, the 'Hafit-type cairns' excavated in Dhank display similar characteristics to these tombs; the structures consist of unworked limestone arranged in two concentric, corbelled ring-walls around a small single chamber (Williams and Gregoricka 2013: 146).

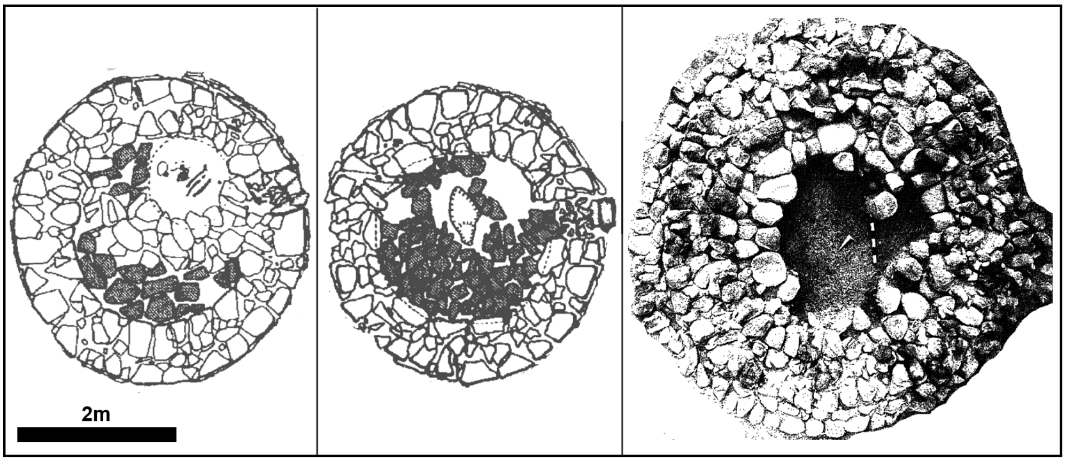


Figure 1.10: Scale plans of Hafit tombs: cairn 2, cairn 3 and 3:17 (altered after de Cardi, Bell, et al. 1979: figs 3, 4; Weisgerber 1980: fig. 53)

Some of the most common Hafit tombs are similar to these examples, but with an additional outer wall (Figure 1.11). At al-Ayn, Tomb 6 is almost identical to Tomb 7, except the structure has an extra ringwall, built in a similar fashion, but with less pronounced corbelling. An entrance leads through both walls, but the doorway in the outer wall was blocked with rubble (Döpper and Schmidt 2014: 222; Schmidt 2010). Likewise, ST103 at Shenah is similar to ST2, but with the addition of a second ring-wall (al-Belushi and ElMahi 2009: 34). Shi23 at Shir is built in a near identical fashion with slabs of local limestone. Two walls were built, with regular facing on their outer side and irregular inward facing, the space between these ringwalls was packed with stone debris, and an easterly entrance into the tomb was walled up (Yule and Weisgerber 1998: 226–228). While flat slabs of sedimentary rock allow for neater facing, less naturally suitable material was also used. Great care was taken in the construction of tombs at Jabal Hafit with the same two wall model being used — a corbelled inner wall and a outer wall with a packing of small stones — with the rough local stone masonry carefully laid in courses. Passageways were corbelled through the walls and topped with lintels to create an entrance, in some cases the floor was levelled before the construction of the tombs, and the floor of the single chambers are frequently paved with small stones. Typically these tombs are 6–7m in diameter, surrounding a round chamber of ~2m (Cleuziou, Vogt, and Méry 2011; Cleuziou, Pottier, et al. 1977). Hafit tombs excavated at RJ-6 are very similar (Cleuziou and Tosi 2007; Santini 1987a). Tomb III at Jabal al-Emalah also follows a broadly similar design, but on a much larger scale — despite a normal-sized chamber, the external diameter of the structure is ~11m and the walls show no sign of corbelling making it unusual (Benton and Potts 1994: 20–23).

More elaborate Hafit tombs simply add additional ringwalls or other features to this basic form (Figure 1.12). G2 at Ghoryeen consists of two ring walls of wadi cobbles, with a small stone packing between, but the structure also has a wide plinth running around it (al-Jahwari 2010); although it is yet to be published Tomb 4 near Bisya shares a similar structural design (Orchard and Orchard 2007: 148). Even more elaborately, 601 — a 7m diameter tomb at Bat — has three ringwalls forming a well preserved, corbelled, false dome around a paved, oblong chamber with a 2.5m corbelled passageway for access, as well as a low plinth, about half a meter in width, running all the way around it (Weisgerber et al. 2007; Frifelt 1975a,b). Cairn 1 at Tawi Silaim is similar, with three ring walls and a plinth encircling a single, paved burial chamber. However, unlike tomb 601, the easterly entrance through the innermost wall was blocked with rubble and the outer walls were then constructed around the burial chamber, completely preventing access into the tomb and forming a large structure 9m in diameter (de Cardi, Doe, and Roskams 1977). Although badly damaged, two large tombs — projected diameters of 12 and 13m — with three or more ringwalls have been excavated at Salut (Degli Eposti and Phillips 2012: 89).

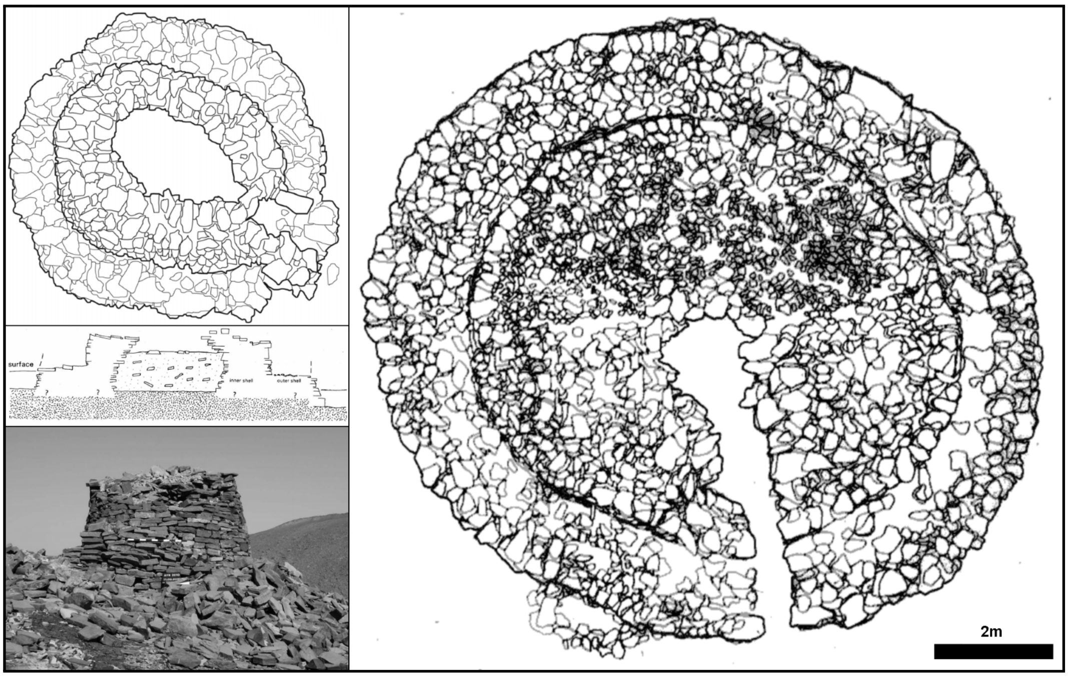


Figure 1.11: Scale plans and photograph of Hafit tombs: cairn 3, Shi23, tomb 6, tomb III (altered after Cleuziou, Vogt, and Méry 2011: fig. 21; Yule and Weisgerber 1998: fig. 51; Schmidt 2010: fig. 10, D.T. Potts)

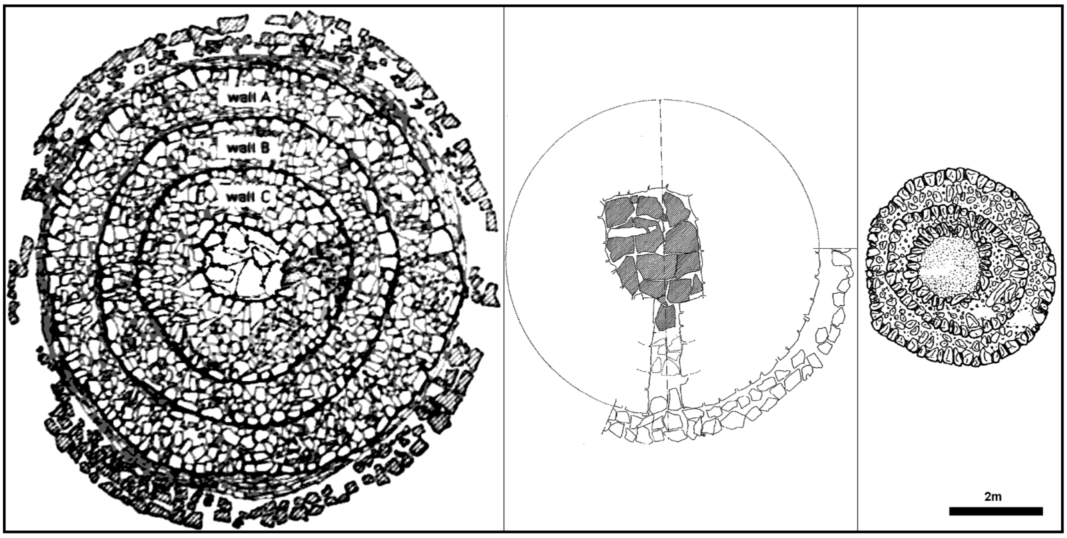


Figure 1.12: Scale plans of Hafit tombs: cairn 1, tomb 601 and G2 ((altered after de Cardi, Doe, and Roskams 1977: fig. 2; Frifelt 1975a: fig. 21; al-Jahwari 2010: fig. 12)

The 'standard' Hafit tombs show considerable variation, but there is even more diversity in 'transitional' Hafit tombs. In the published literature the 'transitional' distinction is made by the excavators, and alludes to shared characteristics with later Umm an-Nar tombs. In a number of cases this is the choice of building materials (Figure 1.13). Bat tomb 603 was faced with "strikingly fine crystalline" pale limestone sourced from a geological deposit some 7km from the site. The blocks were not finely worked like Umm an-Nar 'sugar-lump' tomb facing stones, but they were split, likely to achieve a white colour at the break (Böhme 2011). The Shir 'tower tombs' were not faced with exotic material, but the local stone that was used was finely worked to produce a convex shape to the outer face, exhibiting impressive masonry skills characteristic of the later Umm an-Nar period. In other respects, these tombs resemble somewhat exaggerated Hafit tombs. Shi1 is 6m in diameter, and has a single corbelled wall preserved to an extraordinary height of 5.5m; while Shi2 has two walls and a double corbelled vault, with false domes at 2.2m and an impressive 7.3m. Their triangular entrances and stone paving is typical of many Hafit tombs, as well as an irregular interior wallface (Yule and Weisgerber 1998). Tomb S007-003 at Al-Khubayb is unusually large, with a round chamber 4m in diameter, and it exhibits very fine corbelling (Williams and Gregoricka 2013: 143). The 'pre-Umm an-Nar tombs' at Shenah exhibit similar characteristics — they are larger and were constructed to a very high standard, and some facing stones were simply worked (al-Belushi and ElMahi 2009: 34–35).

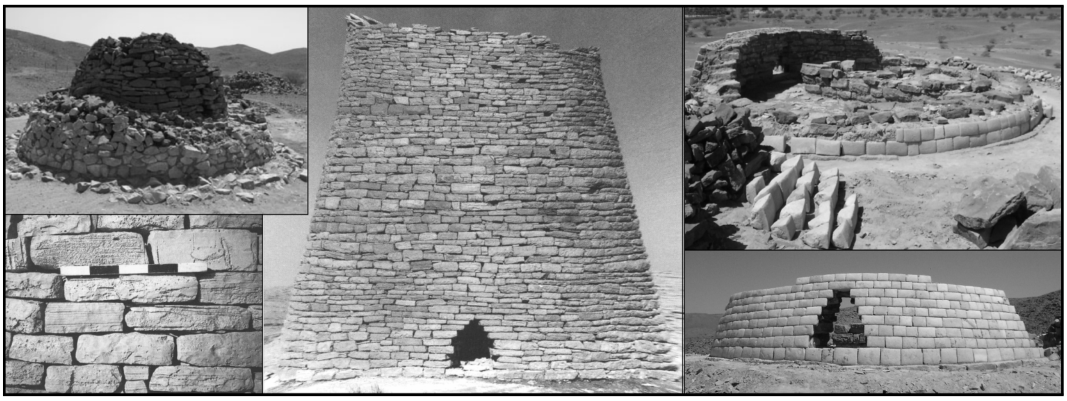


Figure 1.13: Photographs of transitional Hafit tombs and a comparable Umm an-Nar structure: 603, Shi2, Shi1, 401 (Umm an-Nar) (altered after Böhme 2011: fig. 4; Yule and Weisgerber 1998: figs 17, 34; Weisgerber, Heckes, and Böhme 2006: 11–12)

Other 'transitional' Hafit tombs share other architectural similarities with Umm an-Nar funerary structures, in particular internal walls that create multiple burial chambers (Figure 1.14). Tomb 602 at Bat has a short and stubby supporting wall that protrudes into the chamber, similar to double-chambered Umm an-Nar tombs ('tomb 1138' Frifelt 1975a: 69; 1975b: 383–384). K2 at Kalba bears an even closer resemblance to an Umm an-Nar tomb. The structure has a longer supporting wall directly opposite its entrance dividing the tomb into two chambers; otherwise it resembles a large Hafit tomb — it was constructed out of local wadi boulders of various sizes and once had a corbelled roof covering the two chambers (Eddisford and Phillips 2009: 112–113).

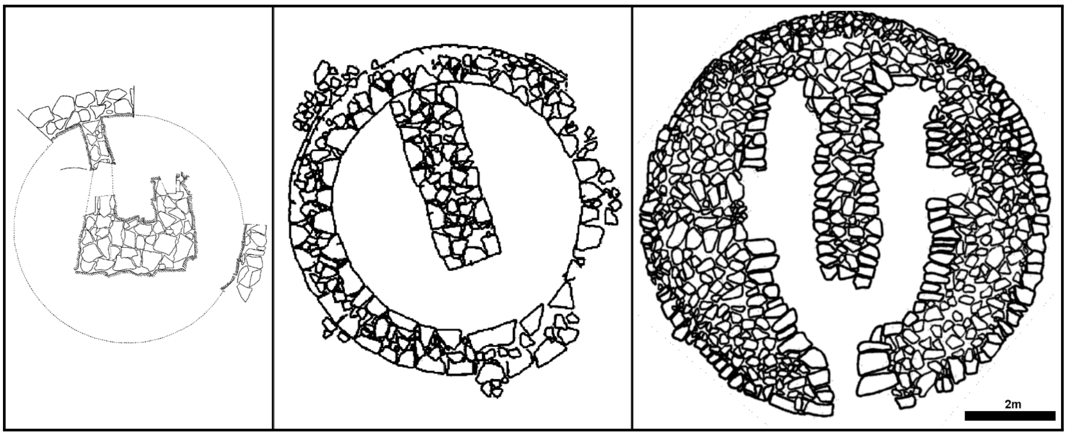


Figure 1.14: Scale plans of transitional Hafit tombs and a comparable Umm an-Nar tomb: 602 (1138), 401 (Umm an-Nar tomb) and K2 (altered after Frifelt 1975a: fig. 23; Böhme and al-Sabri 2011: fig. 3; Eddisford and Phillips 2009: fig. 4)

Tomb I at Jabal al-Emalah and BHS 88 at Jabal Buhais are almost identical, resembling a number of two and four chambered Umm an-Nar tombs (Figure 1.15). Tomb I is a circular tomb, 6.5m in diameter and consists of a single ring wall of local stone, some of which shows evidence of rough working. Unusually, the tomb has two short internal walls that split the tomb into four small chambers. In some of these the remains of the external wall pitches sharply into the space, limiting the area that needed to be roofed; the remains of a cobbled floor survives in some chambers (Potts 2012: 374–375; Benton and Potts 1994: 27, 30). Less has been published on BHS 88, but the 5.5m diameter tomb is nearly identical in form (Jasim 2012). Tomb S007-001 at al-Khubayb has not been drawn in plan, but appears to be very similar — it has internal walling separating the space into four ovoid chambers, separately corbelled and forming an ‘H-shape’; the structure is also better preserved, standing to a current height of 2.9m (Williams and Gregoricka 2013: 141–142).

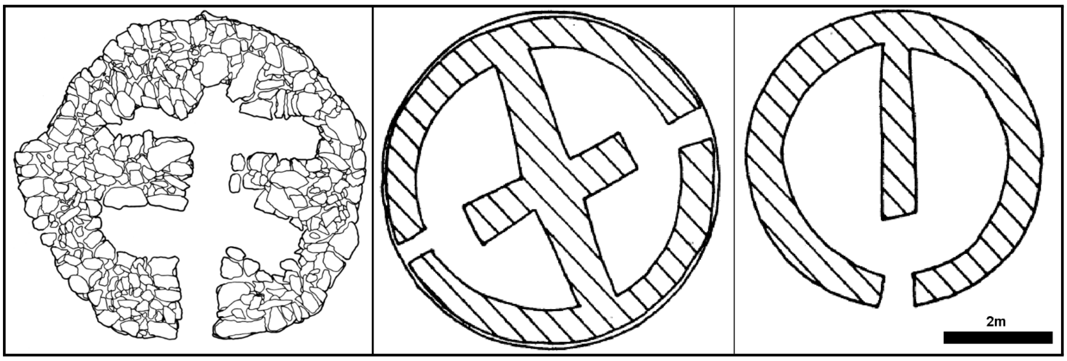


Figure 1.15: Scale plans of transitional Hafit tomb and comparable Umm an-Nar structures: tomb I, unlabelled tombs at Bat (Umm an-Nar) (altered after Potts 2012: fig. 4; Frifelt 1975b: fig. 2)

Distribution

The distribution of Hafit tombs in the landscape also shows considerable variation that is rarely discussed in the literature. This section will summarise the tombs' geographical distribution, their place in the landscape, and their spatial relationship with each other.

Hafit tombs are found in a wide variety of geographical areas: they have been reported as far west as Ra's al-Aysh (Vogt, Gockel, et al. 1989) — less than 200km from Qatar — and at the easternmost point of Oman at Ra's al-Jinz (Cleuziou and Tosi 2000): a 700km wide band across the northern Oman Peninsula, but they are mostly concentrated in northern Oman and the very eastern part of the UAE (Figure 1.16). Within this huge area they are generally found in three environmental zones: the coast; large wadi systems; and the mountains.

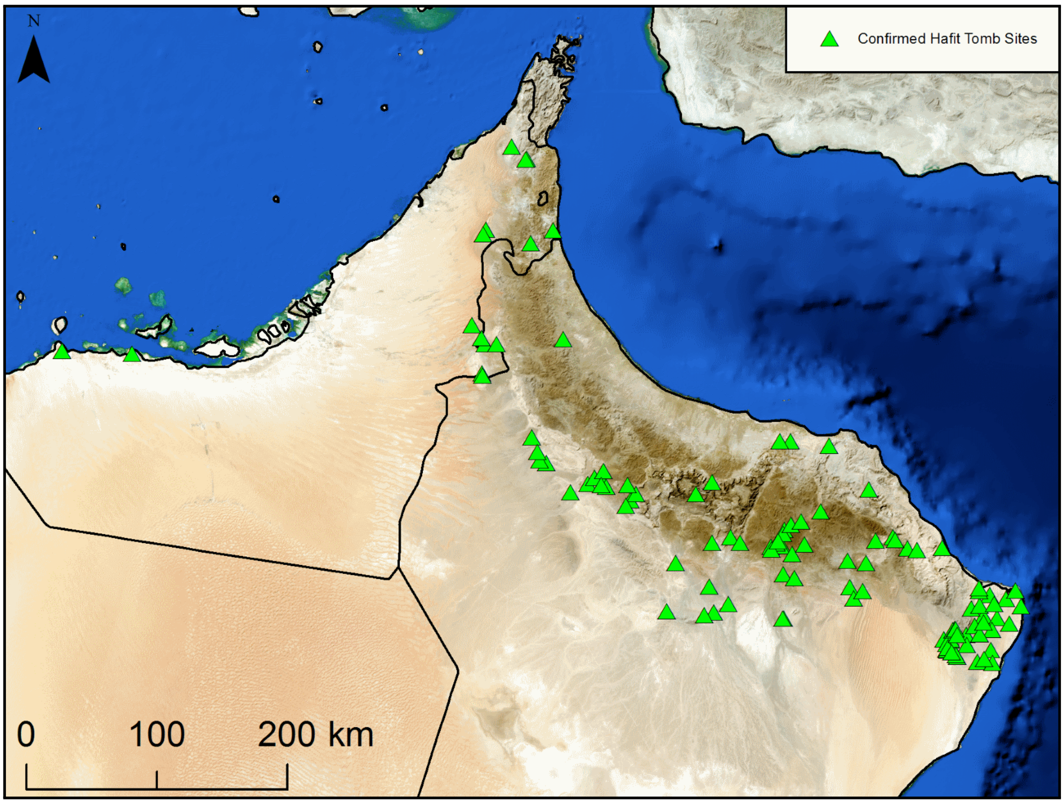


Figure 1.16: Map of known Hafit tomb sites across the northern Oman Peninsula (Appendix A.1)

Hafit tombs are most densely distributed within the large wadi systems of the interior of Oman, on the southern side of the Hajar Mountains (Figure 1.17). Working from east to west, these include: Wadi Batha; Wadi al-Qabil; Wadi 'Andam; Wadi Halfayn; Wadi Adam; Wadi Bahla/Sayfam; Wadi Lusayl/al-Kabir/al-Ayn; Wadi Dhank; Wadi as-Sawmahan; Wadi Ajran; and Wadi al-Ain. Well known sites in the Wadi Batha basin include the large number of tombs around Tawi Silaim (de Cardi, Doe, and Roskams

1977; de Cardi, Bell, et al. 1979), Bilad Bani Bu Hassan (Edens 1990; 1987) and western Ja'alan (al-Jahwari 2013a). Hafit tombs have been recorded in great numbers in the upper sections of the Wadi al-Qabil basin (al-Belushi and ElMahi 2009). The huge watershed of Wadi ‘Andam is well known for its dense distribution of Hafit tombs which have been thoroughly researched (Deadman 2014; 2012a; al-Jahwari 2013b), and further tombs have been surveyed and excavated in Wadi Samad — a major branch of Wadi ‘Andam — around the sites of Samad and Maysar (Weisgerber 1981; 1980). The Wadi Halfayn basin also boasts a significant number of Hafit tombs including the fine examples at Zukayt (Yule and Weisgerber 1998: 202, 204), as does the nearby basin of Wadi Adam to the south (Giraud, Charbonnier, et al. 2012). Huge groups and smaller clusters of Hafit tombs were recorded in some of the earliest surveys in Oman in Wadi Bahla/Sayfam (Humphries 1974), the largest group of tombs in this area is near the village of Bisya (Condoluci et al. 2014; Orchard 2000). The Wadi Lusayl/al-Kabir/al-Ayn system contains some of the most well known Hafit tomb sites including Bat (Frifelt 1975a) and its neighbouring sites (Cable 2012), and the exquisitely preserved tombs near the village of al-Ayn (Döpper and Schmidt 2014; Schmidt 2011; 2010). Recently, Hafit tombs have been recorded in large numbers at three cemeteries in the neighbouring basins of Wadi Dhank and Wadi as-Sawmahan (Williams and Gregoricka 2013). Finally, Hafit tombs have been recorded in the Wadi Ajran basin at Mazyad (Frifelt 1975a), and in greater numbers on the other side of Jabal Hafit and in the surrounding area of the Wadi al-Ain basin (Cleuziou, Vogt, and Méry 2011; Frifelt 1971; During-Caspers 1971).

Although most Hafit tomb sites are clustered in these interior wadi basins on the southwestern side of the Hajar Mountains, there are a few notable exceptions. They have been reported in large numbers in the Wadi al-Qawr basin in the north of the Oman Peninsula (Phillips 1997). There are also a small number of known sites in wadi basins on the other side of the Hajar Mountains, including in Wadi Suq/al-Jizzi (Düring and Olijdam 2015; Frifelt 1975b), and further east around the Wadi Sumayil/al-Khod area[1], and at the nearby site of Halban (Yule and Weisgerber 1998: 201–204).

As well as within large wadi basins, Hafit tombs have also been reported — sometimes in great numbers — along the rocky parts of the coastline of the northern Oman Peninsula. They are present in great numbers along much of the coast of Ja'alan (Figure 1.18), the easternmost region of Oman (Giraud and Cleuziou 2009). A considerable number have also been recorded further north on the coast at the mouth of Wadi Tiwi (Schreiber and Häser 2004). However, there is no record of Hafit tombs along a great stretch of the coastline northwest of here, until Kalba in the U.A.E. where they have been discovered in hills not far from the sea (Eddisford and Phillips 2009). Hafit tombs are much less

[1]observed by the author

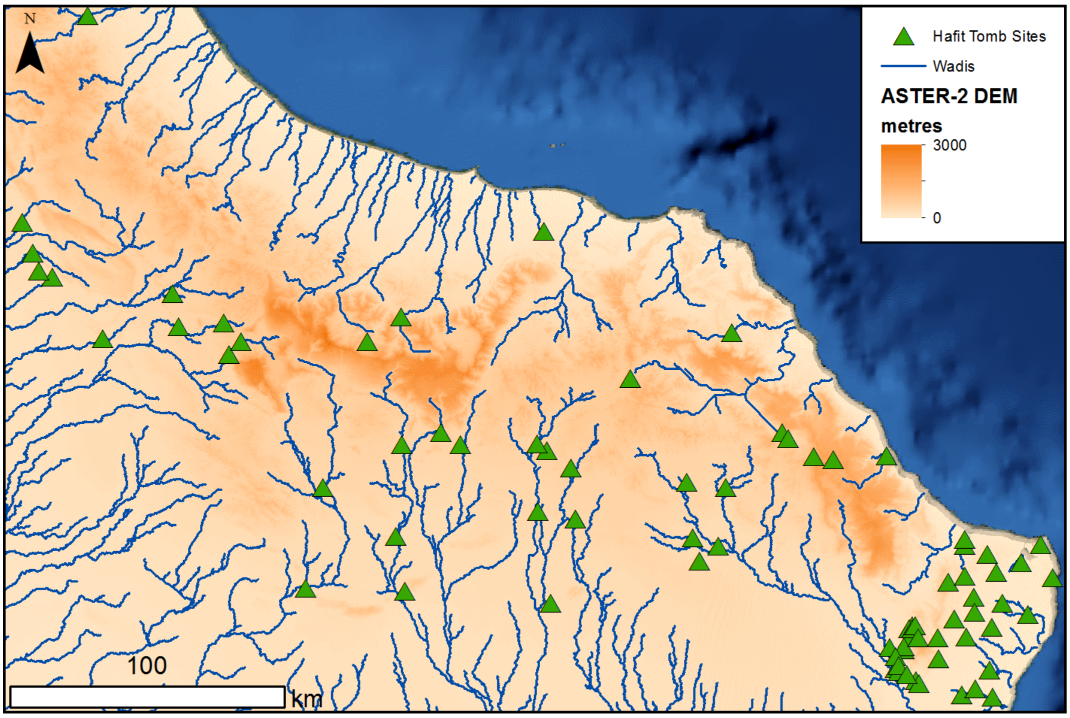


Figure 1.17: Concentration of Hafit tomb sites within the large wadi systems south of the Hajar Mountains (Appendix A.1)

common on the western coast of the U.A.E., possibly because the Arabian/Persian Gulf coastline is much flatter and less rocky. Late Hafit/early Umm an-Nar tombs have been reported at Umm an-Nar island (al-Tikriti 2011: 66; Frifelt 1991: 127; Vogt 1985b). Much further west at Ra's al-Aysh, a rocky promontory, Hafit tombs have been excavated, but not fully published (Vogt, Gockel, et al. 1989).

Finally, Hafit tombs are also sometimes found on high ridges and plateaus in the Hajar Mountains. Survey around the site of Shir led to the discovery of a significant number of Hafit tombs at elevations above 1,700m (Yule and Weisgerber 1998). Hafit tombs have also been recorded in small numbers at even higher elevations on the Saiq Plateau of Jabal Akhder (Schreiber 2004b). Occasionally solitary Hafit tombs, often very well preserved, have been found on mountain summits, such as at Wadi Bani Jabir in the Eastern Hajar range (Cleuziou and Tosi 2007: 117). No published material has reported the presence of Hafit tombs high in the mountains further north in the U.A.E. or in Musandam at the northern tip of the Oman Peninsula, although a small number are known here according to unconfirmed reports (Derek Kennet, pers. comm.).

It is widely observed that Hafit tombs are built on elevated areas of the landscape (Figure 1.19) on mounds; hills; plateaus; ridges; crests; and cliffs (e.g. Williams and Gregoricka 2013; Giraud and Cleuziou 2009; Cleuziou and Tosi 2007; Gentelle and Frifelt 1989; Humphries 1974). However, despite the fact that generally tombs were built "on the more elevated areas" of the local terrain (Deadman 2012a: 30), they are also

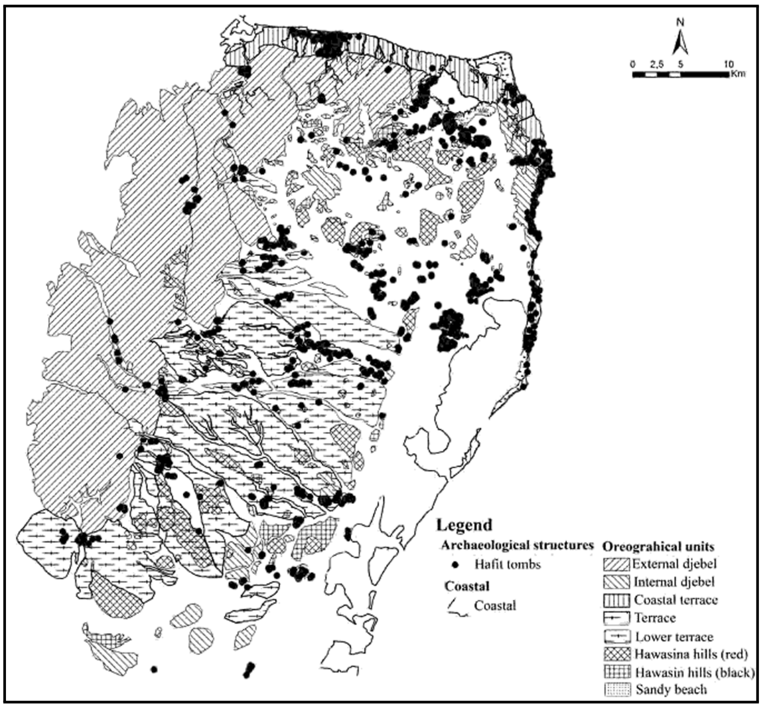


Figure 1.18: Hafit tombs mapped in Ja'alan, eastern Oman (altered after Giraud and Cleuziou 2009: fig. 5)

frequently discovered in less ostentatious locations. For example, in the Ibri area it has been observed that although they appear to prefer ridges, Hafit tombs are also found at the foot of hills and mountains (Gentelle and Frifelt 1989: 122), while similarly in Sharqiyah cairn fields have been reported "on ridges lines, on cemented wadi terraces or on uncemented gravel terraces within wadis, and on sloping cemented fans" (Edens 1990: 44). Similar observations have been made elsewhere including Bat, Ra's al-Jinz, Bisya and Tawi Silaim (e.g. Böhme 2011; Cleuziou and Tosi 2007: 92; Orchard 1995; de Cardi, Doe, and Roskams 1977). They are not only found in low-lying areas when the more prominent locations are already occupied — at Jabal al-Emalah the tombs are built at the foot of the mountain and none are found at greater heights (Benton and Potts 1994: 9). It is possible that the elevated areas of local terrains have provided a "landscape of survival" (cf. Wilkinson 2003), that Hafit tombs survive in better condition in more elevated areas than at the foot of hills, making these tombs more visible in the landscape and biasing our opinion regarding their distribution. General opinion among many archaeologists is that there are chronological differences in distribution, with tombs being located at progressively lower parts of the landscape as the Early Bronze Age develops (e.g. Giraud and Cleuziou 2009: 167–168, fig. 2), although this theory is as yet unproven.

Figure 1.19: Hafit tombs on elevated ridge in the Wadi ‘Andam area, (author’s photo)

Other factors also appear to have influenced Hafit tomb distribution within local landscapes. An obvious point is that these structures are located on *rocky* ridges, hills or outcrops (e.g. Salvatori 2007; Cleuziou, Pottier, et al. 1977) — i.e. where building material was readily available (Giraud 2010: 72). Only rarely is the provenance of tomb construction material considered (e.g. de Cardi, Bell, et al. 1979: 63), and although the Hafit population does not appear to have been particularly selective (Giraud and Cleuziou 2009: 173), appropriate raw material is not universally available and depends on the local geology.

The relationship between the distribution of Hafit tombs and other resources is less clear. It is frequently observed that Hafit tombs may be found in close proximity to modern settlements (al-Jahwari 2013b; Cleuziou and Tosi 2007; Biagi 1988), although what this signifies is difficult to ascertain (Deadman 2012a).

At sites in the interior of the northern Oman Peninsula Hafit tombs are usually found in close proximity to wadis, often being located on high ground running parallel to the line of the course of the channels (e.g. Gentelle and Frifelt 1989). For example, in the Wadi ‘Andam region on average Hafit tombs are located only 750m away from a major watercourse (Deadman 2012a). At coastal sites Hafit tombs are commonly found near important local resources, including fishing beaches (Cleuziou and Tosi 2007: 118–119) and former ancient lagoons in Ja’alan (Salvatori 2001).

Characterising the spatial relationship between Hafit tombs is extremely difficult — very little research has been carried out on the subject, and often survey and excavation reports do not contain the necessary data in sufficient detail. Accurately describing the size of Hafit cemeteries or clusters is problematic, as it very much depends on what constitutes such a grouping (cf. Giraud 2010; 2007). Hafit tombs have been reported in their hundreds in areas across the region including Jabal Hafit (Cleuziou, Pottier, et al. 1977); Bat (Gentelle and Frifelt 1989); Bisya (Orchard 2000); Wadi ‘Andam (Deadman 2012a); Shenah (al-Belushi and ElMahi 2009); Tawi Silaim (de Cardi, Doe, and Roskams 1977); Dhank (Williams and Gregoricka 2013); and numerous sites in Ja’alan (Giraud 2010).

The spatial relationship within and between these groups is little understood. In Ja'alan it is reported that 'necropolis' centres are dense and the peripheries sparser with an area of absence until hitting the next necropolis (Giraud and Cleuziou 2009: 173) — i.e. a core-periphery pattern (Giraud 2010: 74). Although this is the only area to be specifically studied in this way, a similar pattern may be apparent from the description of Hafit tomb distribution around Dhank, Bat and Bisya (Williams and Gregoricka 2013; Gentelle and Frifelt 1989; Orchard 2000). However, in Wadi 'Andam the distribution of Hafit tombs is different (Figure 1.20) — they are not clustered in discrete groups but run along parallel to the larger water courses in an almost continuous distribution (Deadman 2012a).

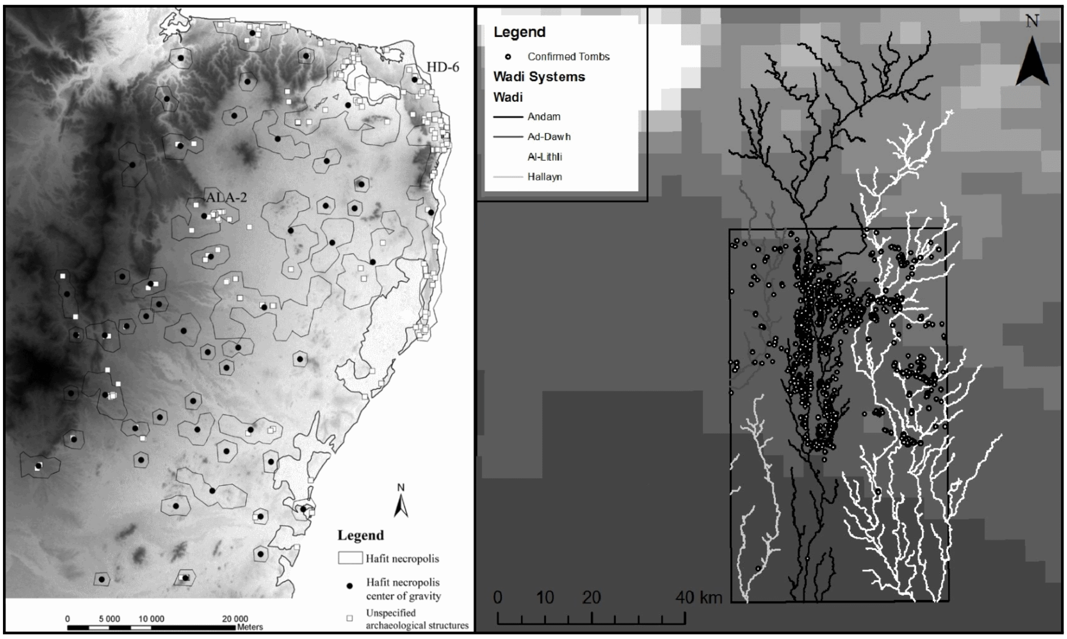


Figure 1.20: Distribution patterns of Hafit tombs in Ja'alan and Wadi Andam (altered after Giraud and Cleuziou 2009: fig. 6; Deadman 2012a: fig. 5)

However, Hafit tombs are also frequently found in smaller numbers — 58 on the Shir Plateau; 35 at Halban and 21 at al-Ayn (Yule and Weisgerber 1998). Even smaller groups are also common: the site of Jabal al-Emalah consists of only three isolated Hafit tombs (Benton and Potts 1994). Such medium and small groups, including isolated and paired tombs, were discovered during a thorough ground survey of Ja'alan (Giraud 2010).

Within larger cemeteries, some have sought to sub-define smaller clusters: HD-10 is described as four clusters of five or six Hafit tombs (Salvatori 2001); a similar pattern is reported in Wadi 'Andam, although occasionally a Hafit tomb is completely isolated (al-Jahwari 2008: 148). In Ja'alan, clusters of tombs within a 'necropolis' are separated by several hundred metres, while within these clusters tombs are separated by a distance of between only several metres and a hundred metres (Giraud 2010: 77). In the Dhank cemeteries tombs are clustered in groups of three or four (Williams and Gregoricka 2013: 145).

Hafit tombs frequently run in single rows, regularly spaced, along a ridge or outcrop (Figure 1.21) — this is most clearly apparent at sites with large numbers of tombs such as al-Khutma, Bat and Bisya (Williams and Gregoricka 2013; Gentelle and Frifelt 1989; Orchard 2000), but this is also seen in smaller groups such as al-Ayn (Döpper and Schmidt 2014)Schm10.

Figure 1.21: Hafit tombs running along a ridge at al-Ayn (Schmidt 2010: fig. 9)

Grave goods

Assessing Hafit grave goods is problematic as their inventories have been altered in the thousands of years since their construction. Frequently almost nothing is found in excavated tombs, having been completely looted in antiquity (e.g. Böhme 2011: 25–28; Schmidt 2010: 9). Furthermore, it is often reported that Hafit tombs were frequently reused for later burials in the Umm an-Nar, Wadi Suq and Iron Age periods (e.g. al-Jahwari 2010; Vogt 1994). What is known of Hafit grave goods will be briefly summarised below, including: pottery; beads; copper and bronze; and other less common furnishings. The most commonly recovered secondary material will also be briefly described.

Pottery vessels — the vast majority almost certainly imported from Mesopotamia — were frequently deposited in small numbers in Hafit tombs. Although apparently as many as fifty pots have been recovered during the excavation of Hafit tombs (Méry and Schneider 1996: 81), the number of published examples does not quite match this number (Table 1.4).

Table 1.4: Published pottery recovered from Hafit tombs

Site	Tomb	Reference	Page	Illus.	Photo
Al-Ayn	Tomb 6	(Schmidt 2010)	8		fig. 12
Bat	1138 AKA 602	(Frifelt 1975a)	69	fig. 12	
Bilad Bani Bu Hassan	N/A	(Edens 1990)	45	fig. 41-2	
Buraimi	I	(During-Caspers 1971)	28	fig. 4	fig. 3
	II	(During-Caspers 1971)	29	fig. 6	fig. 5
Hijar	1141	(Frifelt 1975a)	59	fig. 2	
	1141	(Frifelt 1975a)	59	fig. 1	plate 13
Jabal al-Emalah	I	(Benton and Potts 1994)	41	fig. 50	fig. 58
	I	(Benton and Potts 1994)	40	fig. 50	fig. 55
	III	(Benton and Potts 1994)	39	fig. 50	fig. 54
	IV	(Benton and Potts 1994)	38	fig. 50	fig. 51
Jabal Buhais	BHS 69	(Jasim 2003)	89	fig. 10	
		(Jasim 2003)	89	fig. 10	
	BHS 72	(Jasim 2003)	92	fig. 21	
Jabal Hafit	DC 1	(Frifelt 1971)	380	fig. 12	fig. 1
	DC 13	(Frifelt 1971)	381	fig. 19	
	DC 14	(Frifelt 1971)	381	fig. 19	
		(Frifelt 1971)	381	fig. 19	
	DC 16	(Frifelt 1971)	381	fig. 20	
		(Frifelt 1971)	381	fig. 20	
	DC 2	(Frifelt 1971)	381	fig. 13	
		(Frifelt 1971)	381	fig. 13	
	DC 22	(Frifelt 1971)	382	fig. 21	
		(Frifelt 1971)	382	fig. 21	
		(Frifelt 1971)	382	fig. 21	
	DC 23	(Frifelt 1971)	382	fig. 22	
		(Frifelt 1971)	382	fig. 22	
	DC 8	(Frifelt 1971)	381	fig. 17	fig. 1
	DC 9	(Frifelt 1971)	381	fig. 18	
	FC 3	(Cleuziou, Pottier, et al. 1977)	15	fig. 18	
		(Cleuziou, Pottier, et al. 1977)	15	fig. 18	
Kalba	K2	(Eddisford and Phillips 2009)	113	fig. 4	
Al-Khubayb	S007-001	(Williams and Gregoricka 2013)	143	fig. 12	
	S007-003	(Williams and Gregoricka 2013)	144		fig. 13
		(Williams and Gregoricka 2013)	144		
Al-Khutma	S002-001	(Williams and Gregoricka 2013)	141		
Maysar	25:2	(Weisgerber 1981)	199		
Mazyad	1317	(Frifelt 1975a)	61	fig. 4	
	1320	(Frifelt 1975a)	63	fig. 7	plate 14
		(Frifelt 1975a)	65	fig. 8	
	1321	(Frifelt 1975a)	66	fig. 9	plate 15
		(Frifelt 1975a)	66	fig. 10	
Qarn Bint Sa'ud	N/A	(Méry and Schneider 1996)	81		
Ra's al-Jinz	RJ-6	(Cleuziou and Tosi 2007)	114		
Tawi Silaim	2	(de Cardi, Bell, et al. 1979)	71–72	fig. 6	
		(de Cardi, Bell, et al. 1979)	71–72	fig. 6	
		(de Cardi, Bell, et al. 1979)	71–72	fig. 6	
		(de Cardi, Bell, et al. 1979)	71–72	fig. 6	
		(de Cardi, Bell, et al. 1979)	71–72	fig. 6	
		(de Cardi, Bell, et al. 1979)	71–72	fig. 6	
	4	(de Cardi, Bell, et al. 1979)	72–73	fig. 7	
Zukayt	N/A	(Cleuziou and Tosi 2007)	113–114		fig. 102

The number of vessels included in Hafit tombs tends to be low — usually only one vessel, although two pots are quite frequently found in the same structure (e.g. Williams and Gregoricka 2013: 144; Cleuziou, Pottier, et al. 1977: 15), three vessels is very unusual (Frifelt 1971: 382), while the six or more fragmented pots found in a tomb in Tawi Silaim may well suggest that at least some were deposited in a later period (de Cardi, Bell, et al. 1979: 71–72).

By far the most common pottery vessels are small carinated jars (Figure 1.22). Usually, these have a flat base, a squat carinated body with a ridge running along their shoulder, with a straight or slightly curved neck leading to a thin bevelled rim. However, there is significant variation within this basic form: bases are occasionally rounded or have rings; the width and sharpness of the carination varies considerably — some bodies are almost round — as does the relative height of the widest point of the body; the shoulder ridge may be more or less pronounced, or even absent; the angle, length and shape of the neck varies considerably; as does the thickness and width of the rim. The size of these carinated jars also varies: heights range from 22.5 cm to 8.5 cm (Frifelt 1971). The wares are grit/sand tempered: their colour ranges broadly from buff to orange to brown to pinkish red (e.g. Frifelt 1975a; 1971; During-Caspers 1971; de Cardi, Bell, et al. 1979); a green coloured jar is unique (Frifelt 1975a: 66). Frequently, the surface of the pottery is too damaged to ascertain whether or not it was slipped or painted (e.g. Benton and Potts 1994: 38), but in better preserved examples the jars are covered with a cream slip and decorated with plum-red and black paint to form polychromatic panels of geometric designs (e.g. During-Caspers 1971). Petrological and chemical analysis of a number of these vessels has demonstrated definitively that they came from Mesopotamia (Méry 2000; Méry and Schneider 1996). They have clear parallels at a large number of sites in Mesopotamia and Iran in layers dating to the Jemdet Nasr or Protoliterate C-D period (Matthews 2002; Lamberg-Karlovsky and Tosi 1973; Steve and Gasche 1971; Nagel 1964; Le Breton 1957; Woolley 1955; Delougaz 1952; Lloyd and Safar 1943; Heinrich 1931; Mackay 1931; Schmidt 1931). Other than this single, if varied, form the only other pottery to be found in 'standard' Hafit tombs is a single example of an ovoid jar with a pointed base that has parallels in Jemdet Nasr Mesopotamia (Frifelt 1971: 379; Woolley 1955); and a coarse handmade red ware reported at Jabal Hafit and Tawi Silaim (de Cardi, Bell, et al. 1979: 71–72; Frifelt 1971: 381), which probably dates to the Iron Age.

There is chronological variation in the pottery recovered from Hafit tombs — the ceramic assemblages of 'standard' Hafit tombs differs significantly from 'transitional' tombs (Potts 2012), although only a small number of vessels have been recovered from the latter (Table 1.5, Figure 1.23).

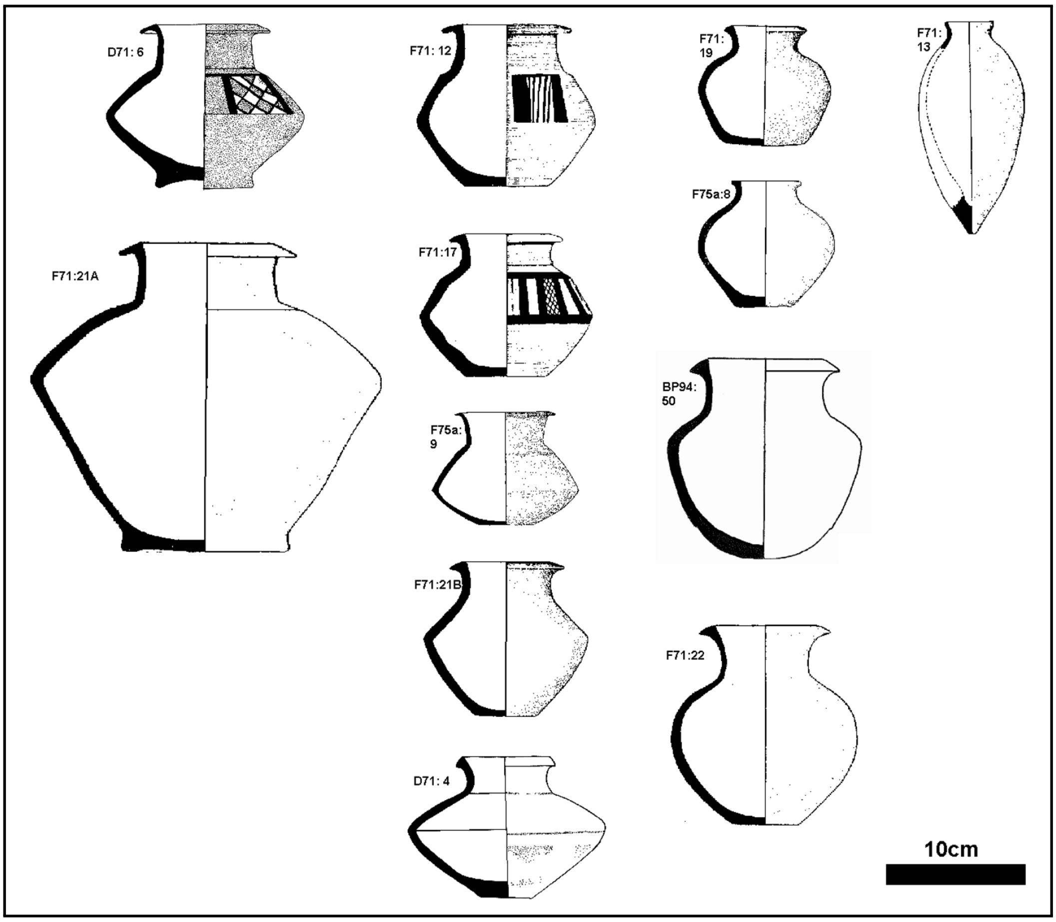


Figure 1.22: Selection of pottery recovered from Hafit tombs (altered after During-Caspers 1971: figs 4,6; Frifelt 1971: figs 12, 13, 17, 19, 21, 22; 1975a: figs 8, 9; Benton and Potts 1994: fig. 50)

Table 1.5: Published pottery recovered from transitional Hafit tombs

Site	Tomb	Reference	Page	Illus.	Photo
Bat	1138 AKA 602	(Frifelt 1975a)	69	fig. 12	
Bilad Bani Bu Hassan	N/A	(Edens 1990)	45	fig. 41-1	
	N/A	(Edens 1990)	45–46	fig. 41-3	
Jabal al-Emalah	I	(Benton and Potts 1994)	41	fig. 50	fig. 58
		(Benton and Potts 1994)	40	fig. 50	fig. 55
Jabal Buhais	BHS 69	(Jasim 2003)	89	fig. 10	
		(Jasim 2003)	89	fig. 10	
	BHS 72	(Jasim 2003)	92	fig. 21	
Kalba	K2	(Eddisford and Phillips 2009)	113	fig. 4	

A round, highly carinated jar, with a round base and a bevelled rim from Kalba (Eddisford and Phillips 2009) and a similar vessel from Bilad Bani Bu Hassan (Edens 1990: fig. 41-1), have clear parallels in Early Dynastic II and III levels in Mesopotamia (Delougaz 1952: plates 74, 102; Moon 1987: figs 319–320; Woolley 1934: plate 253). A jar recovered from Jabal Buhais is very similar in form, but with the straight rim that is also seen in other jars at the same sites (Woolley 1934: 255). Similarly, a sherd with a diagnostic 'band rim' recovered from another Jabal Buhais tomb, is almost certainly an ED III Mesopotamian import (Moon 1987: figs 438–442; Woolley 1934: plate 254), and identical pottery has been recovered from the Umm an-Nar period cemetery and settlement at Umm an-Nar Island (Frifelt 1995; 1991). Two flat-based, round jars from Tomb I at Jabal al-Emalah lack any foreign parallels (Potts 2012; Benton and Potts 1994), but can be compared to pottery from the early Umm an-Nar period at Umm an-Nar Island (Frifelt 1991: figs 102, 206). A rim sherd of dark grey ware with red slip and dark grey paint bears closest resemblance to Umm an-Nar black-on-red wares in form and decoration (Edens 1990: 45–46, fig. 41-3).

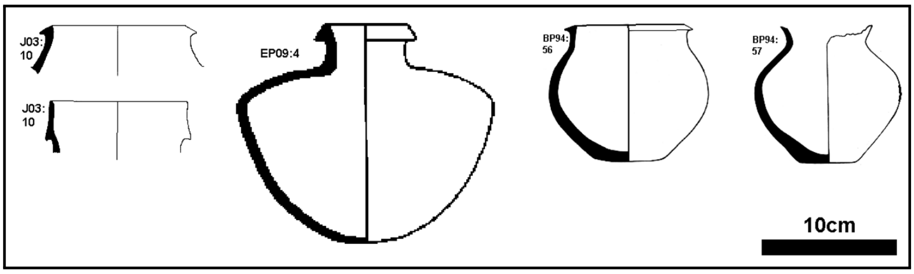


Figure 1.23: Pottery recovered from transitional Hafit tombs (altered after Benton and Potts 1994: figs 56, 57; Jasim 2003: fig. 10; Eddisford and Phillips 2009: fig. 4)

In addition to pottery, two soft-stone vessels have been recovered from Hafit tombs. A small cylinder decorated in the 'figurative style' from a 'transitional' tomb at Kalba is almost certainly an Iranian import datable to the ED II–III (Eddisford and Phillips 2009: 113–114). A small steatite bowl was tentatively associated with the Jemdet Nasr period (Frifelt 1971: 379, 381); although the amateurish decoration with dot-in-circle motif and incised oblique lines make it much more likely to be a later Wadi Suq deposit (cf. David 1996).

Beads are the most commonly found artefacts in Hafit tombs: they have been recovered from most excavated tombs and often number in hundreds or sometimes thousands (Table 1.6).

Describing the beads is problematic, because the terms used to describe the materials from which they are made vary. However, the materials may be classified into six broad groups (Table 1.7, Figure 1.24). Soft-stone beads are common and materials include chlorite, serpentine, steatite, talc and calcite. Chalcedony beads are fairly ubiquitous in low numbers, especially carnelian and agate. Beads of rock crystal have also been found, especially quartz. Other stone is more unusual but include haematite, radiolarite and limestone, as well as other rocks that could not be identified except by colour. A great number of beads of heat altered minerals have been recovered from Hafit tombs. Steatite is baked at high temperatures to make it harder, either in a bead shape or after being

Table 1.6: Bead assemblages recovered from excavated Hafit tombs

Site	Tomb	Number	Reference
Bat	1137	1	(Frifelt 1975a: 69)
Buraimi	Cairn 1	13	(During-Caspers 1971: 29)
Jabal al-Emalah	Tomb I	1148	(Benton and Potts 1994: 30, 48–56)
	Tomb III	1079	(Benton and Potts 1994: 25, 48–56)
	Tomb IV	414	(Benton and Potts 1994: 19, 48–56)
Jabal Buhais	BHS 69	50+	(Jasim 2003: 89)
	BHS 88	100s	(Jasim 2012: 127)
Jabal Hafit	FC 1	2	(Cleuziou, Vogt, and Méry 2011: 18)
	FC 2	2	(Cleuziou, Pottier, et al. 1977: 15)
	FC 3	20	(Cleuziou, Vogt, and Méry 2011: 23)
	FC 6	30+	(Cleuziou, Vogt, and Méry 2011: 30)
	DC 12	1	(Frifelt 1971: 381)
	DC 13	1	(Frifelt 1971: 381)
	DC 19	1	(Frifelt 1971: 381)
	DC 21	2	(Frifelt 1971: 382)
	DC 3	1	(Frifelt 1971: 381)
	DC 8	1	(Frifelt 1971: 381)
	DC 9	2	(Frifelt 1971: 381)
Al-Khubayb	S007-001	2	(Williams and Gregoricka 2013: 143)
	S007-003	2+	(Williams and Gregoricka 2013: 144)
Al-Khutma	S002-001	10	(Williams and Gregoricka 2013: 141)
Maysar	3:17	1-10	(Weisgerber 1980: 91)
	3:18	2	(Weisgerber 1980: 91)
	25:2	1-10	(Weisgerber 1981: 199)
	25:1	1-10	(Weisgerber 1981: 199)
Mazyad	1317	4	(Frifelt 1975a: 61)
	1320	60	(Frifelt 1975a: 63–65)
	1321	4	(Frifelt 1975a: 66)
Ra's al-Hadd	HD 10-3.1	186+	(Salvatori 2001: 69)
	HD 10-3.2	552	(Salvatori 2001: 70)
	HD 10-4.1	1000+	(Salvatori 2001: 70)
	HD 10-4.2	303	(Salvatori 2001: 71)
	HD 10-2.1	49	(Salvatori 2001: 71)
Ra's al-Jinz	RJ-6	1690	(Santini 1987a: 34)
Tawi Silaim	Cairn 1	24	(de Cardi, Doe, and Roskams 1977: 24)
	Cairn 2	89	(de Cardi, Bell, et al. 1979: 73–76)
	Cairn 3	23	(de Cardi, Bell, et al. 1979: 73–76)
	Cairn 4	188	(de Cardi, Bell, et al. 1979: 73–78)

ground into a paste and shaped into the desired form (Benton and Potts 1994: 53). Other very common heat altered material beads include what is variously described as faience, paste, glaze or frit. Metal beads are extremely rare in Hafit tombs — only a single gold-alloy bead has been reported, and silver/lead alloy beads have been found at only one site. Shells of various species have been used as beads, and have been found in significant numbers at a number of sites; bone beads are much rarer, having been reported at only two.

The number of beads recovered from Hafit tombs varies, often depending on the preservation of the grave inventory. Quite frequently only one or two beads are found (e.g. Frifelt 1971: 381). When larger numbers are recovered, assemblages commonly consist of a great majority of small soft-stone or heat altered material beads, and much fewer more precious beads, especially of chalcedony (e.g. Jasim 2003: 89). Frequently only beads of soft-stone or heat altered material are found (e.g. Jasim 2012: 127).

Table 1.7: Classes and examples of bead materials recovered from Hafit tombs

Material	Specific form/example
Soft-stone	serpentine (Frifelt 1975a: 69); talc (Benton and Potts 1994: 48); soft-stone (Jasim 2012: 127); chlorite (Salvatori 2001: 70); steatite (Williams and Gregoricka 2013: 143); calcite (de Cardi, Bell, et al. 1979: 75)
Other stone	purple stone (Benton and Potts 1994: 49); haematite (Cleuziou, Vogt, and Méry 2011: 30); black stone (Frifelt 1971: 381); marble-like stone (Frifelt 1975a: 63); radiolarite (Salvatori 2001: 69); brown stone (de Cardi, Bell, et al. 1979: 75); jade (Williams and Gregoricka 2013: 141); limestone (de Cardi, Bell, et al. 1979: 75); rock crystal (Salvatori 2001: 70); quartz (de Cardi, Bell, et al. 1979: 75)
Chalcedony	agate (During-Caspers 1971: 29); carnelian (Jasim 2003: 89); chalcedony (de Cardi, Doe, and Roskams 1977: 25); jasper (Benton and Potts 1994: 49)
Heat altered mineral	paste (During-Caspers 1971: 29); talcose steatite (Benton and Potts 1994: 49); heated steatite (Cleuziou, Vogt, and Méry 2011: 23); frit (Cleuziou, Pottier, et al. 1977: 15); green-glaze (Frifelt 1971: 381); faience (Salvatori 2001: 70); fired soapstone (de Cardi, Bell, et al. 1979: 75); white steatite (Williams and Gregoricka 2013: 145)
Metal	silver/lead alloy (Benton and Potts 1994: 48); gold alloy (de Cardi, Bell, et al. 1979: 75)
Shell and bone	mother-of-pearl (Cleuziou, Pottier, et al. 1977: 15); shell (Joint Hadd Project 1987: 3); *Conus catus*; *Peribolus arabica*; *Xancus pyrum*; *Olivia inflatum*; *Dentalium*; *Engina mendicaria* (Benton and Potts 1994: 48); Umboninae (Cleuziou, Vogt, and Méry 2011: 30); fish vertebrae (Benton and Potts 1994: 49); bone (Salvatori 2001: 71)

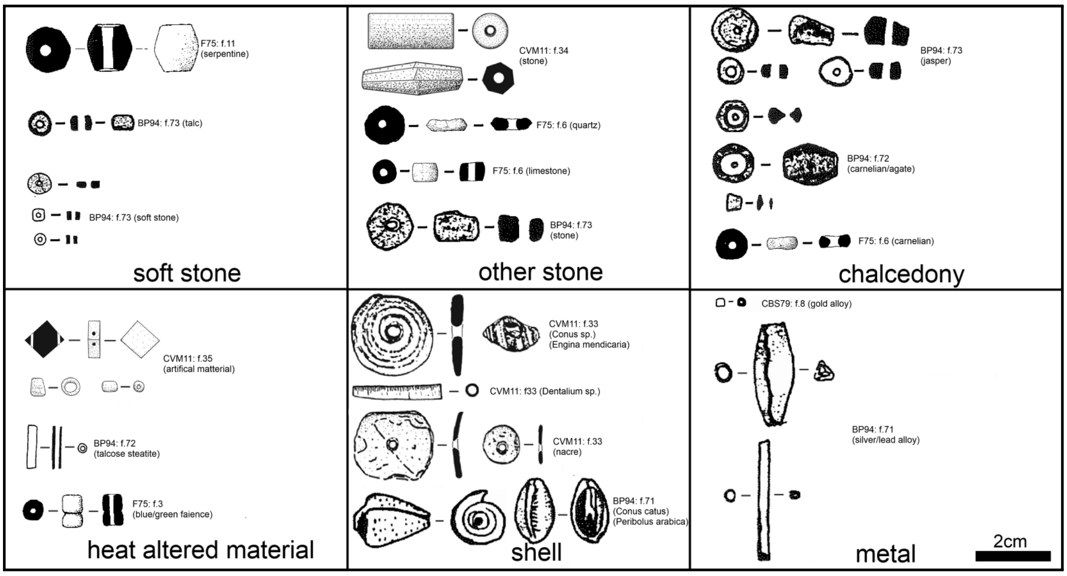


Figure 1.24: Examples of published Hafit beads, by class (altered after Frifelt 1975a: figs 3, 6, 11; Benton and Potts 1994: 71–73; Cleuziou, Vogt, and Méry 2011: 33–35; de Cardi, Bell, et al. 1979: fig. 8)

Most often beads are found loose within the burial layer (e.g. Benton and Potts 1994: 19); although sometimes they are recovered from among human skeletal remains (e.g. Frifelt 1975a: 61), which may suggest they were originally worn as personal ornaments. More rarely they are discovered in their original alignments which demonstrate how they were originally strung or embroidered onto cloth (e.g. Jasim 2012: 127; Benton and Potts 1994: 25).

Many of these beads have parallels from late fourth and third millennia BC sites in Mesopotamia (e.g. McMahon 2006; Matthews 2002; Woolley 1955; 1934); as well as from Umm an-Nar tombs (e.g. Cleuziou, Vogt, and Méry 2011; Frifelt 1991; Vogt 1985a).

Copper/bronze artefacts are frequently found in small numbers within Hafit tombs[2]. Small, pointed tools are the most frequently found copper/bronze artefacts; they are usually described as awls, needles and pins. The majority of these tools are very similar in form (Figure 1.25). They vary in length from 9 to 15cm (Schmidt 2010: fig. 15; Cleuziou, Vogt, and Méry 2011: fig. 31), and are usually less than half a centimetre thick (Benton and Potts 1994: 57; Salvatori 2001: 67). The shafts are square or rectangular in cross section, ending in a rounded point (Frifelt 1971: 382; Schmidt 2010: 9). It is not known what function these objects served — whether as pins, awls or even hairpins (Frifelt 1971: 379). One copper/bronze tool recovered is undoubtedly a large needle — 25cm long and ending at one end in a point and at the other a flat perforated section (Frifelt 1971: 380).

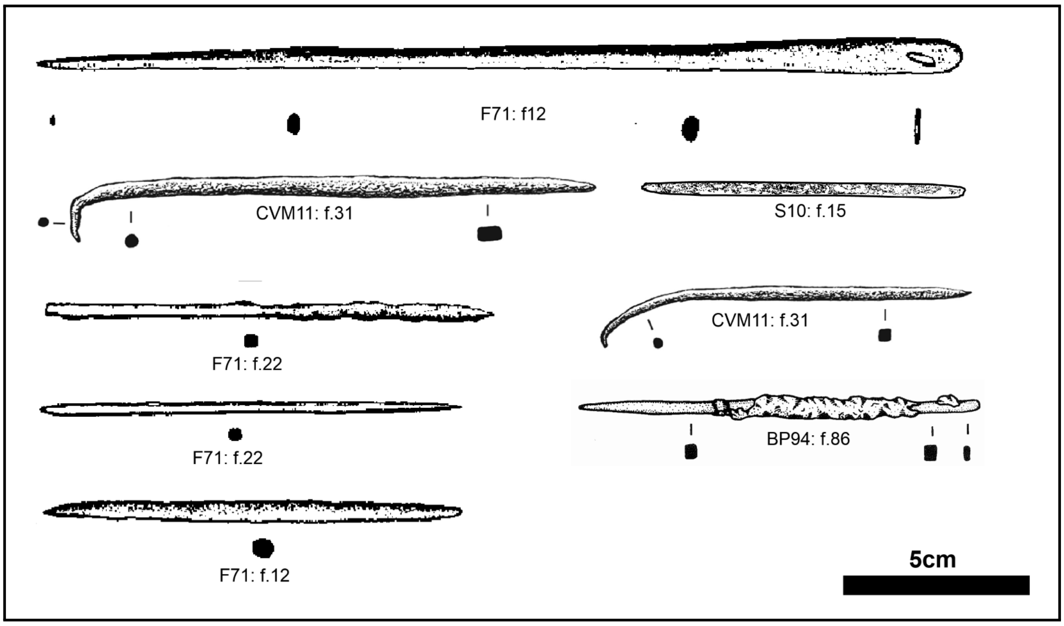


Figure 1.25: Pointed copper tools recovered from Hafit tombs (altered after Cleuziou, Vogt, and Méry 2011: fig. 31; Schmidt 2010: fig. 15; Benton and Potts 1994: fig. 86; Frifelt 1971: figs 12, 22)

Knives — or daggers — are also quite commonly recovered from Hafit tombs (Figure 1.26). Their form varies considerably — ranging from ~12 to 24cm in length (Salvatori 2001: fig. 1.6; Benton and Potts 1994: 57), and ~2.5 to 6.5cm in their maximum width (Salvatori 2001: fig. 1.6; Frifelt 1971: 382). Shapes include long and slender, and broad

[2]Archaeological reports generally make no clear distinction between copper and bronze, and often the terms are used interchangeably and chemical analysis is relatively rare. This chapter will use 'copper/bronze' to reflect this.

and rounded examples, and most have between one and six holes at their base, sometimes complete with rivets (e.g. Williams and Gregoricka 2013: 146). The rivets would have secured the blade to a hilt of organic material: fragments of bone were recovered from one example (Salvatori 2001: fig. 1.6). These rivets are also found loose in Hafit graves — suggesting that the knives or daggers to which they once belonged were looted in antiquity (Cleuziou, Vogt, and Méry 2011: 32). They are small lengths of copper/bronze — between 0.76 and 5 cm (Benton and Potts 1994: 56; Frifelt 1975a: 61) — with a round or square cross section and, usually, flat-hammered ends.

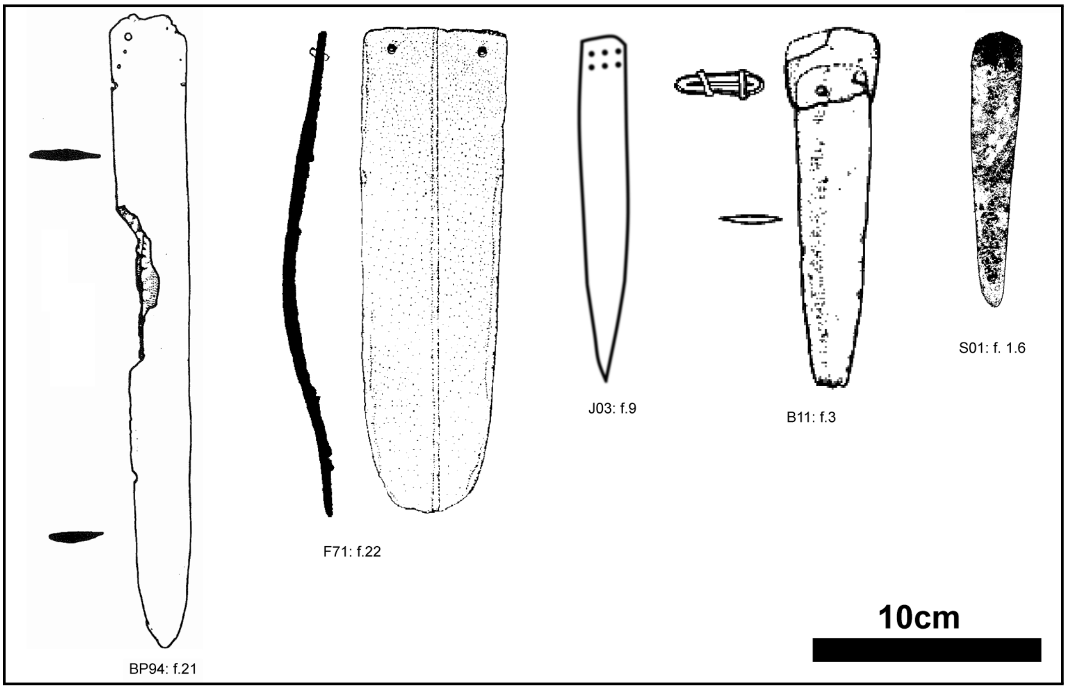


Figure 1.26: Copper knives and rivets recovered from Hafit tombs (altered after Böhme 2011: fig. 3; Jasim 2003: fig. 9; Salvatori 2001: fig. 1.6; Benton and Potts 1994: fig. 21; Frifelt 1971: fig. 22)

Copper/bronze bars have been recovered from tombs at Ra's al-Hadd and Ra's al-Jinz (Salvatori 2001: 70; Santini 1987a: 34). A spatula-like object was recovered at Buraimi and has parallels in contemporary Mesopotamia (During-Caspers 1971: 28-9, 42); while a plate-headed object from a tomb at Bat has very close parallels to the 'razors' of the Umm an-Nar period, and may be a secondary deposit (Böhme 2011: 26–28).

Evidence for copper/bronze jewellery is scarce, and comes only from 'transitional' Hafit tombs. A small bangle was discovered in situ on the arm of a juvenile skeleton at Jabal Buhais, and two copper/bronze rings were found in another tomb at the same site (Jasim 2012: 128; 2003: 87).

A very small number of stone tools have been found in Hafit tombs. Long pointed flint knives from Jabal Hafit and Maysar are the only examples of chipped stone tools (Frifelt 1971: 381; Weisgerber 1981: 199). A small stone hammer found at Ra's al-Hadd cannot be associated with the burial deposit with certainty (Salvatori 2001: 67). Two whetstones from two tombs at Jabal al-Emalah — rectangular slabs ~15x5cm — and a third from Jabal Buhais — of steatite and with similar dimensions — are the only such tools to have been reported (Benton and Potts 1994: 58; Jasim 2003: 87). Three round pebbles, described as possible weights with parallels from Umm an-Nar island, were recovered from a 'transitional' Hafit tomb near Shenah, although the high frequency of tomb plundering and reuse in the area makes it difficult to be sure they are not from a later period (al-Belushi and ElMahi 2009: 35–36).

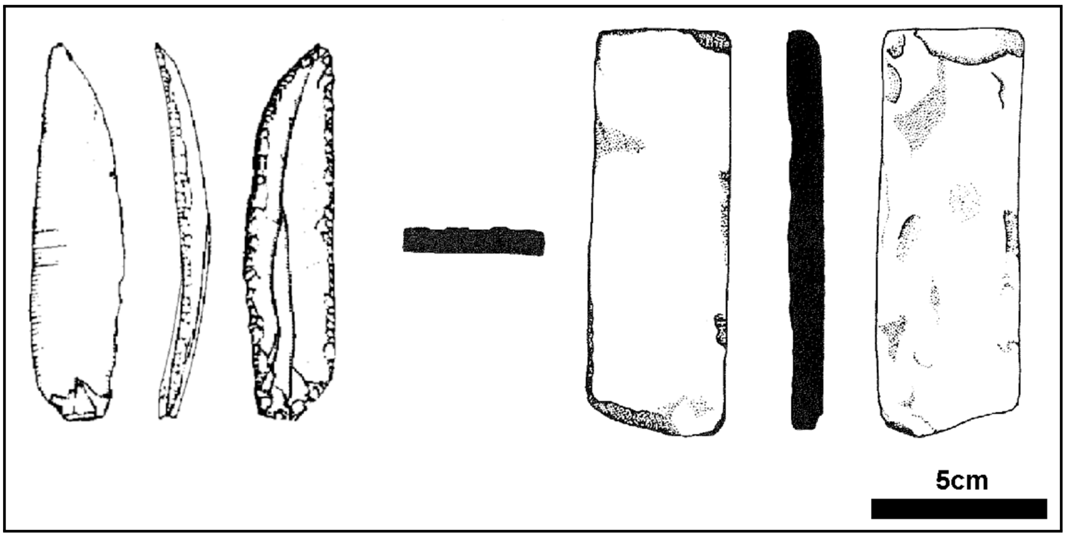


Figure 1.27: Stone tools recovered from Hafit tombs (altered after Frifelt 1971: fig. 16; Benton and Potts 1994: fig. 89)

A perforated limestone prism from Jabal al-Emalah is the only possible seal yet found in a Hafit tomb; it is extremely worn and is identified tentatively (Benton and Potts 1994: 57–58).

In a minority of excavated Hafit tombs, faunal remains have been reported. The majority of these cases consist of sea shells: whole or fragmented specimens of cockle, *Anadara*, and other species including a "feeding shell" have been recovered (Table 1.8).

In other cases, shells have been worked — a single (possibly secondary) *Conus* plate bracelet was found in a tomb at Ra's al-Hadd (Salvatori 2001: 69); while shell rings manufactured from pearl oyster-shell and sea snails have been found at a number of sites (Salvatori 2001: 69; 3 Edens 1990: 48; Santini 1987a: 34; de Cardi, Bell, et al. 1979: 64, 78–79).

Table 1.8: Unworked shells recovered from Hafit tombs

Site	Tomb	Species	Reference
Jabal al-Emalah	Tomb I	'Feeding shell'	(Benton and Potts 1994: 31)
Jabal Dhanna	1	N/A	(Vogt, Gockel, et al. 1989: 55)
Jabal Hafit	DC 1	Cypraeidae	(Frifelt 1971: 380)
	DC 22	Cardiidae	(Frifelt 1971: 382)
Ra's al-Aysh	1	Unspecified	(Vogt, Gockel, et al. 1989: 54)
Ra's al-Hadd	HD 10-3.1	Mussel	(Salvatori 2001: 67)
	HD 10-3.1	*Anadara* species	(Salvatori 2001: 69)
	HD 10-4.1	*Chlamys* species	(Salvatori 2001: 70)

Animal bone deposits are scarce. Animal bones were deposited under human skeletons in a tomb at Maysar (Weisgerber 1981: 91); while a layer of mussel shell, and fish and mammal bone found above the burial layer at Ra's al-Hadd may be a secondary deposit (Salvatori 2001: 67). Perforated shark teeth have been found in tombs at Ra's al-Hadd and Ra's al-Jinz (Salvatori 2001: 70–71; Santini 1987a: 34). Uniquely, remains of cuttlefish sepia were recovered from the burial layer of a tomb at Ra's al-Aysh (Vogt, Gockel, et al. 1989: 54). There is also one instance of butchered animal remains having been recovered from a Hafit burial context (Williams and Gregoricka 2013: 144).

The reuse of Hafit tombs in later periods is frequently reported, although in some cases it is not unlikely that the structures attributed to the Hafit period may actually have been constructed later in prehistory and therefore some may need to be re-evaluated. The recovery of Umm an-Nar ceramics suggest that some tombs may have continued to be used in this period (e.g. Frifelt 1975a: 69; Eddisford and Phillips 2009: 114; Weisgerber 1981: 199). Evidence for Wadi Suq period reuse is fairly common (e.g. Condoluci et al. 2014: 116–117; Häser 2003: 27). The tombs were frequently utilised in the Iron Age (e.g. Benton and Potts 1994: 31; Jasim 2012: 87; de Cardi, Bell, et al. 1979: 73): in one spectacular deposit in a tomb at Jabal Hafit, secondary Iron Age grave goods included bronze and steatite bowls, a long bronze sword and belt buckle and a large shell button 6.5cm in diameter (Frifelt 1971: 381–382).

Human remains

Despite the fact that human remains are found very frequently during the excavation of Hafit tombs, very little research has been conducted examining the skeletal material from this period — even within the context of Arabian archaeology (cf. Blau 1998; 2001). What has been discovered will be briefly summarised: MNI counts and demographics; patterns of deposition; primary burials; and osteoarchaeology.

Assessing the number of individuals interred within Hafit tombs is extremely difficult: in the past skeletal remains were rarely analysed, often because of their severe fragmentation, and as a result often only qualitative descriptions of excavated human remains are available (Table 1.9).

Table 1.9: Unquantified human remains recovered from Hafit tombs

Site	Tomb	Skeletal Remains	Reference
Bat	1137	"a few fragments of human bones"	(Frifelt 1975a: 69)
Hijar	Grave 1141	"a few fragments of human bones"	(Frifelt 1975a: 59)
Jabal Buhais	BHS 64	"few skeletal remains"	(Jasim 2003: 86-87)
	BHS 72	"dispersed and fragmentary skeletal remains"	(Jasim 2003: 92)
Jabal Hafit	FC 1	"two long bone diaphyses"	(Cleuziou, Pottier, et al. 1977: 13)
	FC 5	"fragments of diaphyses of long bones"	(Cleuziou, Pottier, et al. 1977: 15)
	DC 12	"fragments of skull"	(Frifelt 1971: 381)
	DC 13	"skeletal remains"	(Frifelt 1971: 381)
	DC 16	"fragments of bone"	(Frifelt 1971: 381)
	DC 18	"fragments of bone"	(Frifelt 1971: 382)
	DC 23	"skeletal remains"	(Frifelt 1971: 382)
	DC 6	"fragments of bone"	(Frifelt 1971: 382)
	DC 7	"skeletal remains"	(Frifelt 1971: 381)
Kalba	K1A	"a few fragmentary bones"	(Eddisford and Phillips 2009: 112)
	K1B	"a few fragmentary bones"	(Eddisford and Phillips 2009: 112)
Maysar	25:1	"skeletal remains... in quantifiable amounts"	(Weisgerber 1981: 199)
	25:2	"skeletal remains... in quantifiable amounts"	(Weisgerber 1981: 199)
	3:17	"numerous bones and bone fragments"	(Weisgerber 1980: 91)
Ra's al-Hadd	HD 10-2.1	"very few... remains, mainly portions of long bones"	(Salvatori 2001: 71)
Shenah	ST252	"a few unidentified fragments"	(al-Belushi and ElMahi 2009: 36)
	ST12	"a few unidentified fragments"	(al-Belushi and ElMahi 2009: 36)
Shir	Shi23	"unidentified small bone fragments"	(Yule and Weisgerber 1998: 226)

In some cases skeletal remains have been analysed — for example, tombs in Hafit cemeteries in Dhank have produced relatively well-preserved human bone assemblages that have been studied using modern methods (Williams and Gregoricka 2013). Most often a tomb's MNI is estimated to be five or under, but as many as 20–30 individuals have been reported in some cases (Table 1.10).

Relatively few Hafit tomb bone assemblages have been sexed and aged, but the evidence that is available shows some variation in the individuals that were interred in the tombs (Table 1.11). In a sizeable minority only a single, usually male, individual was found to have been interred, while in fewer cases multiple adults were discovered. However, over half of the time tombs contained a range of ages and, when it is possible to differentiate, both sexes. This has lead some to suggest that these tombs may have been constructed and used by nuclear family units (Magee 2014: 94; Williams and Gregoricka 2013: 147; Cleuziou and Tosi 2007: 122).

Skeletal material is most often found in a fragmentary, disarticulated and disordered state (e.g. Jasim 2012: 127; Weisgerber 1980: 91; Frifelt 1975a: 63). Although partially due to looting in antiquity, as well as natural taphonomic processes such as tomb collapse and rodent disturbance (Williams and Gregoricka 2013: 142), the state of the bones is primarily the result of the tombs' repeated use: often the degree of articulation

Table 1.10: MNIs reported from excavated Hafit tombs

Site	**Tomb**	**Hafit**	**Later**	**Reference**
Jabal al-Emalah	Tomb I	5	1	(Benton and Potts 1994: 61-66)
	Tomb III	5	1	(Benton and Potts 1994: 66-69)
	Tomb IV	2	0	(Benton and Potts 1994: 69)
Jabal Buhais	BHS 88	5	1	(Jasim 2012: 127)
	BHS 89	2	0	(Jasim 2012: 128)
Jabal Dhanna	1	1	0	(Vogt, Gockel, et al. 1989: 55)
Jabal Hafit	FC 2	3	0	(Munoz 2011: 219; Cleuziou, Vogt, and Méry 2011: 22)
	FC 3	1	0	(Munoz 2011: 221; Cleuziou, Pottier, et al. 1977: 15)
	DC 14	4	0	(Frifelt 1971: 381)
Al-Khutma	S002-001	1	1	(Williams and Gregoricka 2013: table 2)
Al-Khubayb	S007-001	3	0	(Williams and Gregoricka 2013: table 2)
	S007-003	5	0	(Williams and Gregoricka 2013: table 2)
	S007-039	1	0	(Williams and Gregoricka 2013: table 2)
	S007-095	5	0	(Williams and Gregoricka 2013: table 2)
Maysar	3:18	2	0	(Weisgerber 1980: 91)
Mazyad	Grave 1317	2	0	(Frifelt 1975a: 61)
	Grave 1320	3	0	(Frifelt 1975a: 63)
Ra's al-Aysh	1	1	0	(Vogt, Gockel, et al. 1989: 54)
Ra's al-Hadd	HD 10-3.1	10	0	(Salvatori 2001: 69)
	HD 10-3.2	6	0	(Salvatori 2001: 70)
	HD 10-4.1	22	0	(Salvatori 2001: 70)
	HD 10-4.2	22	0	(Salvatori 2001: 71)
Ra's al-Jinz	RJ-6	29	0	(Santini 1987a: 33)
Tawi Silaim	Cairn 1	2	0	(de Cardi, Doe, and Roskams 1977: 24-25)
	Cairn 2	1	0	(de Cardi, Bell, et al. 1979: 91–92)
	Cairn 3	1	0	(de Cardi, Bell, et al. 1979: 91—92)
	Cairn 4	1	0	(de Cardi, Bell, et al. 1979: 91–92)

Table 1.11: Demographic data of human remains from Hafit tombs

Site	Tomb	MNI	Demographics
Tawi Silaim	Cairn 2	1	Adult male (de Cardi, Bell, et al. 1979: 91)
	Cairn 3	1	Adult male (de Cardi, Bell, et al. 1979: 91)
	Cairn 4	1	Adult, possibly male (de Cardi, Bell, et al. 1979: 91)
Jabal Hafit	FC 3	1	Adult, possibly male (Munoz 2011: 221)
Al-Khutma	S002-001	1	Adult (Williams and Gregoricka 2013: table 2)
Jabal Hafit	FC 2	3	Adults (Munoz 2011: 221)
Ra's al-Hadd	HD-10-3.1	10	Adults (Salvatori 2001: 69)
Tawi Silaim	Cairn 1	2	Adult and sub-adult (de Cardi, Doe, and Roskams 1977: 25)
Jabal al-Emalah	Tomb IV	2	Adult and sub-adult (Benton and Potts 1994: 69)
Al-Khubayb	S007-001	3	Adult male, adult female and a sub-adult (Williams and Gregoricka 2013: table 2)
Jabal al-Emalah	Tomb I	5	Adults and at least one juvenile (Benton and Potts 1994: 61–66)
	Tomb III	5	Adults, juveniles and infants (Benton and Potts 1994: 66–69)
Al-Khubayb	S007-003	5	Two adult females, one adult male and two sub-adults (Williams and Gregoricka 2013: table 2)
Ra's al-Hadd	HD-10-4.1	22	All ages, both sexes (Salvatori 2001: 70)
	HD-10-4.2	22	All ages, both sexes (Salvatori 2001: 71)
Ra's al-Jinz	RJ-6 C1	29	All ages, both sexes (Santini 1987a: 33)

varies as you would expect as a tomb is reused over time — frequently the final inhumation is preserved relatively intact, but is surrounded by the disarticulated bone of previous interments (e.g. Benton and Potts 1994: 30–31). Sometimes disarticulated bone is concentrated along the internal walls of the tombs (e.g. Cleuziou, Vogt, and Méry 2011: 22–23; Benton and Potts 1994: 67), as though remains were pushed to the periphery by the introduction of new interments (Munoz 2011: 224). As well as this accidental movement of human bones, in a small number of cases skeletal material was purposefully rearranged — at HD 10-3.1 in Ra's al-Hadd, skulls were retrieved from within the thick deposit of bone and carefully arranged along one of the tomb walls (Salvatori 2001: 69). It is unclear whether interments were primary, secondary or a combination of the two. The fact that usually some degree of articulation is observed suggests that primary interments were made (e.g. Williams and Gregoricka 2013; Salvatori 2001; Santini 1987a), but whether the disarticulated state of many of the remains can be explained solely by the introduction of successive burials and later disturbance is an area that is yet to be explored. Recently the assumption that all Hafit tombs were collective has been challenged by excavations at Dhank which suggest that the 'standard' Hafit-cairn type structures were only intended for single interments, and that collective burial developed later on in the period; the authors suggest that this contrast with the traditional picture may testify to regional differences in mortuary practices (Williams and Gregoricka 2013: 146).

Individuals appear to have been carefully interred in a specific way apparent in Hafit tombs from across the Oman Peninsula. They were interred with individual grave goods including pottery, personal ornamentation and tools or weapons. In Tomb I at Jabal al-Emalah, one individual skeleton was discovered with a necklace of shell beads around its neck, and associated with a ceramic vessel and a 'feeding shell' (Benton and Potts 1994: 31). In BHS 88 at Jabal Buhais, a long copper/bronze knife was found in contact with the tibia of an individual (Jasim 2012: 127), while at BHS 89 a copper bangle was found in situ around a child's wrist (Jasim 2012: 128). An adult female at al-Khubayb was associated with a pottery vessel, a number of beads and a copper/bronze pin (Williams and Gregoricka 2013: 144). Even where grave goods are not found in situ, they are usually found among human bones, within the same stratigraphic layer (e.g. Frifelt 1975a: 61, 63; Salvatori 2001: 69). When skeletons have been discovered in their original position, they are always found flexed and on their side, although the side and direction varies (Williams and Gregoricka 2013: 140; Benton and Potts 1994: 31; Jasim 2012: 127–128; Frifelt 1975a: 61–63; Salvatori 2001: 69).

Osteoarchaeological analysis of Hafit tomb bone assemblages is rare, making it difficult to garner much information about Hafit society from human remains. Much of the available evidence comes from human teeth due to their superior preservation. At Jabal al-Emalah, the dental material indicated heavy attrition and few carious lesions (Benton and Potts 1994: 61, 67). Similar results were seen at Maysar: severe attrition, infrequent caries and low ante-mortem teeth loss; comparable to analyses of the teeth of modern bedouin pastoralists who are dependent on a mixed subsistence economy of fauna, grain and dairy (Littleton and Frohlich 1993). The dental analysis of material from tombs at Jabal Hafit and Mazyad produced very different results: low attrition and a high frequency of caries — characteristic of a sedentary population engaging in agriculture and animal husbandry (Højgaard 1985), however there was clear evidence of the reuse of some of the Danish tombs being used in later periods which may account for this discrepancy (Frifelt 1971), especially since other dental evidence from elsewhere on Jebel Hafit matches the profile seen more generally (see below).

One of the two more detailed studies of human remains was part of an ongoing project examining Hafit cemeteries around Dhank (Williams and Gregoricka 2013). Analysis of the preserved human remains produced evidence for osteoarthritis and osteophytosis, common age-related degenerative diseases; compression of back vertebra and healed fractures which may testify to a physically strenuous lifestyle in rough terrain; pathologies indicating nutritional deficiencies including *spina bifida occulta* and rickets. Dental remains showed signs of moderate to severe attrition and ante-mortem tooth loss, possibly evidence for occupational use as well as diet (Williams and Gregoricka 2013: 148).

The second detailed examination of human remains was carried out on the skeletal material recovered from two tombs at Jebel Hafit some thirty years previously (Munoz 2011: 218). The bones were fragmented and poorly preserved, but it was possible to make some observations regarding the teeth of the individuals including evidence of some cases of ante-mortem tooth loss, periodontitis and moderate wear (Munoz 2011: 221–224).

Although such studies have been carried out for the Neolithic and Umm an-Nar periods (Kutterer and Uerpmann 2017; Zazzo, Munoz, and Saliège 2014; Gregoricka 2013), stable isotope analysis has not yet been carried out on Hafit human remains, which could provide insight into diet and mobility during the period. There is a clear need for further research into Hafit human remains.

1.2 Conclusion

This chapter has sought to summarise the published Hafit archaeological dataset. Hafit settlement evidence is ephemeral, and sometimes contentious and poorly dated. In contrast, Hafit tombs are a significant feature in much of the landscape of the northern Oman Peninsula. This evidence will be discussed later in the thesis as part of an effort to explore the nature of Hafit society (Chapter 8). The literature review continues in the next chapter, summarising the publish opinion on this subject.

Chapter 2

Hafit society

While a substantial amount of archaeological research has been carried out examining the Hafit period, much less effort has been made to understand the nature of Hafit society itself. This chapter will chronologically review what has been published in this area, informing a detailed discussion later in the thesis (Chapter 8).

2.1 Early Hafit research

For the most part, the earliest Hafit archaeological research concentrated on describing the material culture — especially as these early expeditions dealt mostly with material from multiple periods — and placing it within established Southwest Asian chronologies. Thus while de Cardi and Frifelt laid the foundation for all future research into the period (Frifelt 1971; 1975a,b; de Cardi, Collier, et al. 1976; de Cardi, Doe, and Roskams 1977; de Cardi, Bell, et al. 1979), they made no real attempt to understand how Hafit society functioned socially, politically or economically. In their later research, some hints as to how they understood Hafit society appeared — de Cardi suggested that the dense concentration of Hafit funerary monuments around Khatt suggests the sedentary occupation of the area during the period (de Cardi, Kennet, et al. 1994: 43), and Frifelt notes that unlike later funerary structures Hafit tombs do not cluster around modern oases, but rather are spread over larger areas that may relate to former trade routes or mining areas (Gentelle and Frifelt 1989: 124–125).

2.2 The first attempts to describe Hafit society

During-Caspers published the very earliest theory regarding the nature of Hafit society, based upon scant evidence. She argues that the presence of Jemdat Nasr pottery in Hafit tombs were the “traces of a group of Jamdat Nasr settlers or merchants” — a

Mesopotamian trading post or colony in the northern Oman Peninsula (During-Caspers 1971: 43–44; 1970: 250). In later research she describes the Hafit population as "small communities of farmers and herdsmen growing grain and raising cattle" (During-Caspers 1989: 15).

Although largely speculative, Brunswig writes one of the earliest and most detailed depictions of Hafit society. He describes a population living in seasonal settlements, with an economy "based on a blend of hunting-gathering and pastoral nomadism", but also at an early stage of agricultural development. He draws parallels with modern Bedouin — a population maintaining seasonally occupied villages that they visit to plant, harvest and maintain cereal and date crops, and argues that this would have been more efficient in the less arid Hafit period allowing the society to later develop into politically centralised, sedentary arable farmers in the Umm an-Nar period (Brunswig 1989: 33–34).

In his Mesopotamian-centric core-and-periphery model, Eden's suggests that there was relatively little contact between the Oman Peninsula and Sumer during the Jemdat Nasr period, with trade between the urban power and the small-scale oasis communities limited to a small volume of luxuries. New and more complex social organisation emerged in the Umm an-Nar period, correlating with a increase in the volume and transparency of trade with Mesopotamia and the Indus (Edens 1992: 130–131).

The research undertaken by the Orchards centring on the Wadi Bahla area produced some detailed depictions of Hafit society, that — being based upon undoubtedly erroneous assumptions regarding chronology and material culture — began and remain very much on the fringe of Arabian archaeology (cf. Potts 1997). Attributing the monumental architectural remains of the Umm an-Nar period to the beginning of the Hafit period, the Orchards argue that by the late fourth millennium BC, huge agricultural settlements — up to 400 hectares in size, dubbed 'al-Hajar oasis towns' — were established in the northern Oman Peninsula. According to the Orchards the population farmed these areas, making use of aquifer-exploiting sub-surface to surface irrigation technology — the introduction of which is conventionally dated to the Iron Age (Lightfoot 2000) — and burying their dead in Beehive tombs on the surrounding foothills (Orchard and Stanger 1994). They argue that these sedentary farmers were migrants from the Yemeni highlands, unrelated to the native Neolithic population. These south Arabian farmers were later joined in the Oman Peninsula by mineral-seeking pioneers from Mesopotamia, who temporarily resided in the oasis towns and buried their dead in Hafit tombs, which must be distinguished from the Beehive funerary structures of the more established Yemeni migrants. These al-Hajar oasis towns were replaced by Umm an-Nar settlements later in the third millennium BC (Orchard 1995). Even in face of opposition from those holding more conventional opinions these eccentric theories were defended and further developed (Orchard and Stanger 1999; Orchard 2000;

Orchard and Orchard 2002; 2007). Although many of their more outlandish theories have not gained widespread approval, the increasing evidence for Hafit round-towers and sedentary agriculture places others closer to the mainstream of current archaeological opinion.

2.3 Cleuziou's model

Based on research at Hili — in the interior of the U.A.E. — and Ja'alan — on the easternmost coast of Oman — Cleuziou has developed the most sophisticated and detailed model for the socio-political and economic structure of Hafit society. He is a firm advocate of cultural evolution (Cleuziou 2002b: 191), and argues that rather than consisting of two separate periods, the Early Bronze Age is a period of cultural continuity without any major breaks until its end in the second millennium BC (Cleuziou 2007b: 212; 2002b: 192; 1982: 19; Cleuziou and Tosi 1989: 19). He argues that society in the Oman Peninsula developed along a unique Arabian evolutionary path shaped by the severe environmental constraints (Cleuziou 2003: 140; Cleuziou and Tosi 1998).

Cleuziou argues that the major developments in Hafit society occurred at the start of the period: a 'great transformation' at the end of the fourth millennium BC (2007b: 211; 1997: 390). He argues that major social, economic and political changes (Cleuziou 2002b: 197; Cleuziou and Tosi 2000: 26), came about through a conscious decision by the population to adopt new agricultural and pastoral technologies that were already available in order to support increasingly complex social developments (Cleuziou 1998: 59, 63). This led to an increase in population and population density, and in the intensity with which Hafit society exploited the environment (Cleuziou 1997: 390; Cleuziou and Tosi 1998: 128; Cleuziou and Munoz 2007: 300). This 'great transformation' resulted in — and is reflected by — the uniform Hafit material culture seen across the northern Oman Peninsula (Cleuziou 2007b: 216-217), which is particularly apparent in the tombs of the periods which are the most visible representation of the developments happening within the society (Cleuziou, Vogt, and Méry 2011: 40; Cleuziou 2002b: 197; Cleuziou and Tosi 2000: 26; 1998: 128).

Early on, Cleuziou suggested that resources were controlled and monitored by local Hafit elites (Cleuziou and Tosi 1989: 33). However, he has since altered his theory in favour of an egalitarian model, based on sharing between equals with wealth evenly distributed throughout the Hafit population (Cleuziou 2007b: 224; Cleuziou and Tosi 2007: 95, 122). He depicts a society organised around kinship on three levels: the nuclear family, the extended family, and the tribe — with the nuclear family sharing a tomb and a house, extended families building tombs and houses in clusters, and the tribe sharing the same settlement and cemetery (Cleuziou and Tosi 2007: 94–96, 122; Cleuziou and Munoz 2007: 309; Cleuziou 2007b: 217; 2003: 141; 2002b: 202). Cleuziou suggests that the landscape was divided into political territories (Cleuziou and Tosi 2007: 121–122; Cleuziou 2002b: 196–197), and that the Hafit social-structure was the precursor to the modern Arabian tribal system (2003: 140; 1998: 63; 1997: 390).

He argues that the Hafit economy was largely based on agriculture, with the full development — very early on — of the oasis-based method of cultivation, with fruit and cereals grown under the shade of palm trees (Cleuziou and Munoz 2007: 298; Cleuziou 2002b: 200; 1998: 59; 1997: 389–390; 1989a: 79–80; 1982: 19). Hafit agriculture would have included irrigation (Cleuziou and Munoz 2007: 298; Cleuziou and Tosi 1998: 129): either well-based (Cleuziou 2002b: 198), or a gravity-based system comparable to modern *falaj* (Cleuziou 1997: 329; 1998: 61). Although this suggestion of sophisticated, sedentary, year-round agriculture is based almost entirely on evidence from excavations at Hili 8 (Cleuziou and Tosi 1989: 25; Cleuziou 1989a), Cleuziou envisages a belt of similar oases on the wadi fans across the interior of the northern Oman Peninsula during the Hafit period (Cleuziou 1998: 60; 1982: 19; Cleuziou and Tosi 1989: 25). Following investigations in Ja'alan, as well as large agricultural settlements — such as Hili 8 — Cleuziou also argues for the cultivation of smaller 'garden settlements' (2009: 734; 2007b: 219). Evidence for animal husbandry of domestic herding animals including caprids and bovids was recovered from Hili 8, with some bones suggesting that cattle may have been used in ploughing or drawing up water (Cleuziou 1989a: 81; Cleuziou and Tosi 1989: 25). Cleuziou suggests that the necessary technology for these developments may have derived from southeastern Iran, Mesopotamia or southern Arabia (Cleuziou 2002b: 201; 1998: 61; Cleuziou and Tosi 2007: 151).

Based on his Hili 8 excavations (1989a), Cleuziou suggests that monumental round-towers — a defining feature of the later Umm an-Nar period — were also present in Hafit oases, but that smaller settlements were also occupied on the coast and inland (Cleuziou and Tosi 2007: 146–148, 94; Cleuziou 2007b: 219). Although oases were permanently occupied, he also argues that they could also have formed part of a seasonal migration pattern between the coast and inland that mirrors a common modern lifestyle (Cleuziou 2007b: 215; 1998: 63; Cleuziou and Munoz 2007: 309; Cleuziou and Tosi 2000: 67). Fishing would have been practised outside of the monsoon season, when winds and fish migrations make it impossible, and in these summer months the population would have moved to inland agricultural settlements or to grazing areas with their animals (Cleuziou 2007b: 214–215; 2003: 138; Cleuziou and Tosi 2007: 93; 2000: 41; Cleuziou and Munoz 2007: 309).

As well as agriculture, Cleuziou suggests that copper metallurgy was also developed in the late fourth millennium BC and used locally for knives, needles, pins and fish-hooks (2007b: 211; 2002b: 200). He links oasis agriculture and the development of copper technology — noting the need for fuel, transport, leather and organised labour in metallurgy (1998: 59; 2002b: 201). He suggests that copper was also traded to other polities in the wider region, especially the early states of Mesopotamia and southeastern Iran (Cleuziou 2007b: 211; Cleuziou and Tosi 1989: 17; Berthoud and Cleuziou 1983). This contact with local powers was valued by the local Hafit population, and made possible by many of the transformations that occurred within society at the time (Cleuziou 2002b: 201; 1998: 59; Cleuziou and Tosi 2007: 83–84). The development of a local exchange economy, rather than redistribution through a central authority, explains the homogeniety of the Hafit material culture across the northern Oman Peninsula (Cleuziou 2007b: 217; 2003: 139, 141; Cleuziou and Tosi 2007: 97). This trade largely resulted from the production of a surplus of long-living food stuffs, including dates, cereals and processed fish (Cleuziou 2007b: 217; 2003: 139; Cleuziou and Munoz 2007: 309).

Cleuziou also describes parts of the Hafit ideology with regards to their treatment of the dead. Collective Hafit tombs were located on hills surrounding newly created agricultural land, and therefore may be used to locate the presence of third millennium oases (Cleuziou 2009: 731, 734; 2007b: 211, 213, 219; 2003: 138–139; 2002b: 196–197, 201; Cleuziou and Tosi 2007: 116, 141–142; Cleuziou and Munoz 2007: 300) — despite the fact that the nearest Hafit tombs to the only possible Hafit oasis settlement at Hili 8 are 2km away (Cleuziou 1997: 407; 1989a: 83). Hafit tombs were also used to mark ownership of fishing grounds and beaches, and pasture for grazing (Cleuziou 2007b: 211; 2002b: 196; 1997: 407), and to establish tribal territories by marking borders and approaches to agricultural settlements (2007b: 211; 1997: 407). This aspect of his interpretation is heavily influenced by the work of Saxe, Goldstein, Renfrew and Chapman (Chapter 8.3.2).

2.4 The 'Cleuziou school'

A number of recent scholars — his former students — accept Cleuziou's theories regarding the economic, social and political organisation of Hafit society and are seeking to build upon his work and develop his ideas further.

Azzara's research concentrates on the architectural and ecofactual evidence recovered from HD-6 and RJ-2 — Early Bronze Age settlement sites — which were excavated as part of The Joint Hadd project in Ja'alan. She fully accepts the 'great transformation' hypothesis (e.g. 2009: 1), and utilises Space Syntax Analysis and an examination of the evidence for food processing to further develop Cleuziou's ideas regarding the socio-political organisation of Hafit and Umm an-Nar society (2013; 2012a,b; 2009). Based on her analyses, Azzara suggests that the possible Hafit settlement at HD-6 shows something akin to Durkheim's definition of "mechanical solidarity" between the occupants — that they shared a uniformity of beliefs and group structure: stressing the importance of the household as a unit, each being similar but largely independent, but that households do show limited interdependence through the sharing of some of the site's facilities and the construction of the settlement itself (2009: 9; 2012a). She argues that the architectural space at HD-6 suggests that collective efforts were organised beyond the level of individual households, and therefore expresses the evolution of Early Bronze Age society, and the new configuration of territories (Azzara 2013). Her analysis of food processing at the site, suggests that multiple, affiliated nuclear families may have shared the task of processing significant volumes of food to optimise the efficiency of the task (Azzara 2012b: 257). These assertions support and develop Cleuziou's own theories regarding the evolution of Early Bronze Age society, and how it was organised around kinship.

Bortolini's theoretical research develops Cleuziou's evolutionary framework for Early Bronze Age society, asserting that Darwinian Archaeology is a suitable next step, and going on to apply cladistics in the study of third millennium tombs in an attempt to more accurately classify the structures. However, while affirming Cleuziou's theories, Bortolini's highly theoretical research does not in itself add any further insight as to the nature of Hafit society (2012).

Giraud's Hafit and Umm an-Nar tomb research develops numerous facets of Cleuziou's model of Early Bronze Age society. She utilises ground survey and GIS analysis to study the distribution of tombs in Ja'alan (Giraud 2009; 2010; Giraud and Cleuziou 2009) and Adam (Giraud, Mahrooqi, et al. 2010; Giraud, Charbonnier, et al. 2012). By illustrating the spatial correlation between Hafit tombs and areas where palm cultivation is possible, she argues that oasis-based agriculture was carried out in Ja'alan during the Hafit period (Giraud 2009: 747; Giraud and Cleuziou 2009: 176), although such an association by no means proves that such cultivation took place. She also suggests — based on the distribution of the tombs — that Hafit settlements formed a hierarchy with a core-periphery pattern (Giraud and Cleuziou 2009: 176), although she does not elaborate on how this was reflected in the nature of Hafit society, and the collection and quality of the survey data is not discussed. While agreeing with Cleuziou that tombs were constructed in positions to appropriate territory and resources (Giraud and Cleuziou 2009: 181), she argues that this also served to define the living space of the Hafit village, forging a link between the occupants and their new surroundings (Giraud 2010: 79, 83).

However, while her earlier work fully accepted the 'great transformation' hypothesis (Giraud 2009: 742), her more recent findings in Adam are more tentative. Based on results in Ja'alan, she at first expected to find sedentary settlements in the centre of Hafit cemeteries in Adam (Giraud, Mahrooqi, et al. 2010: 177–178). However, she has become more circumspect — asserting that the establishment of an oasis-based agricultural society is only a working hypothesis, without firm evidence, and the Hafit population that built the tombs may have led a nomadic or a sedentary lifestyle (Giraud, Charbonnier, et al. 2012: 6, 10).

2.5 Other recent theories

An increased interest in the archaeology of the Early Bronze Age in recent years has produced numerous theories and depictions of the social, economic and political organisation of Hafit society.

Al-Jahwari's PhD fieldwork examining the distribution of Hafit tombs in Wadi 'Andam (2008; 2013b), and his research examining the tombs of western Ja'alan have contributed to the discussion of the nature of Hafit society (2013a; 2011). The total lack of evidence for sedentary Hafit settlements in Wadi 'Andam led him to propose that the area was occupied by nomadic pastoralists who lived in temporary and perishable tents or huts — this was supported by the discovery of simple stone platforms near some of the tombs. He suggested that the shift towards a sedentary subsistence strategy occurred between the Hafit and Umm an-Nar periods (al-Jahwari 2015: 89; 2013b: 59, 160), although very recently evidence for more substantial Hafit settlement remains has emerged in this region (Schmidt and Döpper 2017). He interpreted the results of a more detailed survey in western Ja'alan similarly, developing his theory further. Drawing comparisons with the present author's research (Deadman 2012a), he suggests that nomadic pastoral groups shifted across the landscape in search of grazing and water for their livestock, and that the seasonal availability of these natural resources made it necessary to mark their territory by constructing tombs (al-Jahwari 2013a: 151). He also draws parallels with modern herding populations, suggesting that winter may have been spent grazing animals on plains and wadis, while during summer they sheltered with sedentary agriculturalists in the foothills (al-Jahwari 2013a: 164–165). He has also raised the issue of the problem of dating Hafit tombs in the field (al-Jahwari 2010), which itself raises issues with the interpretation of tomb distributions.

Rouse and Weeks created an agent-based model to investigate the role of specialisation and exchange in Early Bronze Age society. They suggest that the results of archaeological survey appear to place the beginnings of agriculture at the start of the Umm an-Nar period rather than the Hafit period (2011: 1586). Their analysis leads them to conclude that the introduction of numerous new technologies and specialisations had the potential to increase socio-economic inequality rather than mitigate it, with wealth and resources unequally distributed throughout the population (Rouse and Weeks 2011: 1584, 1589). However, they also note that wealth disparity does not equate to social inequality, and that a society in which wealth and power are dissociated is compatible with Cleuziou's tribal depiction of political organisation — they suggest that the introduction of collective burial in the Hafit period was an ideological response to the destabilisation of society through this disparity (Rouse and Weeks 2011: 1589). They also attempt to shed light on the local and regional trading economy, noting that the 'tribal ethos' of a kinship-based society would have encouraged local exchange as individuals would feel they should participate even if it is against their economic interests (Rouse and Weeks 2011: 1585) — this could have been a factor in contributing towards the homogeneity of the Hafit material culture. They also suggest that the wealthy specialists that would have emerged during the Early Bronze Age would have made a natural class of agents to trade with the outside world (Rouse and Weeks 2011: 1589).

Cable's PhD research in the Bat area have produced unique insights into the society of the Hafit period (2012; n.d.). She asserts that oasis cultivation did begin at the end of the fourth millennium BC, as part of an integrated economy of fishing and agriculture, and describes Hafit society as 'middle-range' (Cable 2012: ii). She argues that the Umm an-Nar round-tower tradition had its roots in the Hafit period, located in or around oasis settlement (Cable 2012: 34). Cable suggests that Hafit tombs provided the medium to mark access and ownership of disparate resources — especially water sources and arable soil (2012: 204–204). The tombs also provided the means by which social integration was achieved and enacted — the low-level of skill required to construct Hafit tombs meant that all members of the community could participate in the building of the monuments in which they would later be interred; demonstrating cultural solidarity that signalled 'culture-wide access' to the identity and resources of the group (Cable 2012: 205–206; n.d.). She strongly supports the depiction of Hafit society as 'tribal' and kinship-based (Cable 2012).

The present author's remote sensing-based research in Wadi 'Andam has also shed some light on Hafit society (Deadman 2014; 2012a,b). I argue that the distribution of Hafit tombs suggests that the population inhabiting the area were not sedentary agriculturalists but nomadic pastoralists, making use of wadi channels as pathways through the terrain in search of water and grazing for their animals. Erecting highly-visible tombs on the hill-sides allowed the population to advertise their ownership of the land in absentia, while herding in other parts of their territory (Deadman 2012a: 33). Field-based examination of the orientation of Hafit tomb entrances allowed the present author to add greater detail to this theory. Data from the three sites that were examined suggested that the sun played a significant role in Hafit society, and that the position of the sunrise was recorded in the tomb architecture (Deadman 2014: 142). However, based on data from other sites, I note the existence of different practices in the western part of the Oman Peninsula — perhaps suggesting regional differences in belief systems (Deadman 2014: 147). I also argue that the migration of the Hafit population was seasonal — that they exploited the temporary availability of water and grazing in the northern elevated areas in the winter, and moved to the southern plains in the summer where perennial resources had been rested and replenished (Deadman 2014: 146).

The survey and excavations carried out by the SoBO project in the Dhank area of Oman have yielded significant results (Williams and Gregoricka 2013). Their investigation of Hafit tombs has led them to believe that the population that constructed the funerary monuments were nomadic pastoralists that transformed over time into sedentary farmers and herders by the Umm an-Nar period (Williams and Gregoricka 2013: 146). They uniquely document the changing funerary customs through the Hafit period, including tomb architecture, furnishings and the increasing number of interments (Williams and Gregoricka 2013). The number and sex/age ratio of individuals buried in later tombs add weight to the suggestion that the were used by nuclear families (Williams and Gregoricka 2013: 147). As research continues it is to be expected that the project will uncover much more about the local Hafit population.

Magee's recent book attempting to summarise the archaeological dataset of prehistoric Arabia takes a balanced approach in discussing Hafit society. He stresses that there is still little evidence available to shed light on the local economy during the period (Magee 2014: 94). While acknowledging that Hili 8 testifies to a transition from a pastoral to a sedentary agricultural lifestyle, he suggests that overall evidence for fully developed agriculture is very meagre, and that the development of this technology is more likely to have taken place at an early point in the Umm an-Nar period (Magee 2014: 94–97). He also points out that there is little concrete evidence for the use of channel-based irrigation, nor for local copper production in the Hafit period (Magee 2014: 95–96). He acknowledges that the enormous number and spread of Hafit tombs indicate a shift in landownership and use during the period, and argues that with the return to moist conditions this may have consisted of the spread of pastoralism into previously inhospitable areas — postulating the practice of an agropastoral subsistence strategy combining pastoralism with temporary agriculture (Magee 2014: 97–98). With regards to the socio-political organisation of Hafit society, he notes that any "manifestation of 'social complexity' [is] difficult to ascertain" (Magee 2014: 97).

2.6 Conclusion

After a relatively slow beginning, discussion of Hafit society has been given greater attention in recent times. However, even now relatively little has been written on the subject, and many significant questions remain. In terms of social organisation, current published opinion is unanimous that the Hafit population was 'kinship oriented' — more detailed theories suggest three levels of social organisation: the nuclear family, the extended family, and the tribe. However, this model rests on a relatively small body of tenuous evidence: extremely limited osteoarchaeological research; a house-plan of a poorly dated settlement; and unproven observations on the clustering of tombs. In terms of economic strategies, scholars are equally divided between the Hafit practice of widespread sedentary agriculture, and the predominance of nomadic pastoralism. The importance of trade — including local exchange in spreading a homogeneous material culture; and region-wide trade in technically and ideologically encouraging the development of greater complexity in society — is stressed by many, but there is little evidence for how these systems functioned. Politically, an egalitarian model of Hafit society is dominant — power not being restricted to an elite — but opinion is divided as to whether wealth was equally or unequally distributed throughout the population. The concepts of Hafit territories and territoriality are frequently discussed, but the existence of such political units is yet to be demonstrated. A great deal of mystery remains as to how society functioned in the late fourth and early third millennium BC in the northern Oman Peninsula.

Part II

Data Collection

Chapter 3

Assessing the accuracy and precision of Google Earth Hafit tomb survey in western Ja'alan

3.1 Introduction

Remote sensing lies at the core of data collection in this thesis — using Google Earth to locate and map the distribution of Hafit tombs. The aim of this chapter is to gauge the efficacy of the basic method. The accuracy and precision of the survey methodology will be assessed, revealing its strengths, weaknesses and limitations. The results of this investigation will dictate how it may, and may not, be used in Hafit tomb research, shaping the approach to be taken in later chapters and in future work. A control dataset of Hafit tombs — meticulously collected on the ground by a Sultan Qaboos University (SQU) survey team over multiple seasons — is compared to the results of a Google Earth survey of the same study area. Much of this chapter forms part of a journal article already published (Deadman and al-Jahwari 2016).

Firstly, some background information about the SQU western Ja'alan survey — the control dataset — will be presented. Next, the Google Earth survey methodology will be described, as well as the approach taken to compare the two datasets and assess the accuracy and precision of the method. Finally, the comparison of the results of the two surveys will be presented and discussed.

3.2 Background — the SQU western Ja'alan survey

Over three seasons between 2010 and 2012 a SQU team, directed by Nasser al-Jahwari, surveyed a small part of western Ja'alan in Sharqiyah (Figure 3.1), northeastern Oman (al-Jahwari 2013a; 2011). The aim of the project was to document the archaeological remains of the area and to investigate its settlement history (al-Jahwari 2013a: 152). Although covering a modest area (~159 sq-km), ecologically the study area boasts a physiographical cross-section that is fairly representative of the northern Oman Peninsula, with numerous wadis running down through a mountainous zone, into a wide and flat plain made up of alluvial fans, and then into desert (al-Jahwari 2013a: 153–154). The study area was divided into sub-areas, and each was meticulously surveyed on foot across all types of terrain, painstakingly checking for archaeological features which were recorded within a database. A large number of diverse archaeological sites were found, including rock art, triliths and ancient settlements, but Hafit tombs make up the majority of sites with 5,012 of the funerary structures being discovered (al-Jahwari 2013a: 155–156).

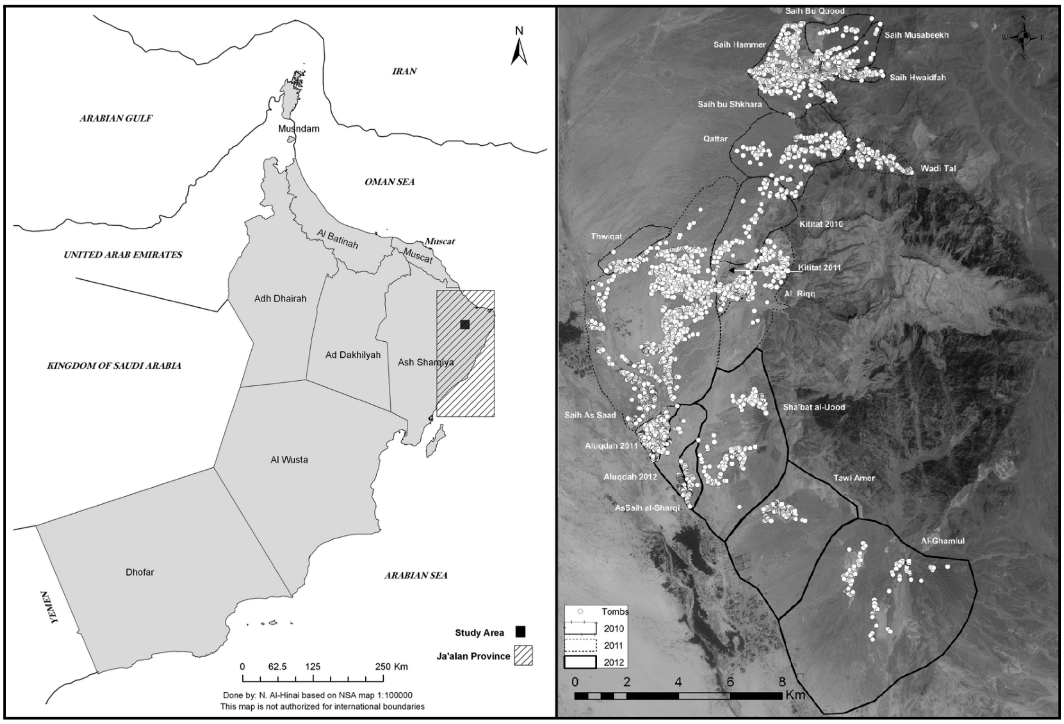


Figure 3.1: SQU survey study area in western Ja'alan, ash-Sharqiyah, showing subdivisions of the area and the Hafit tombs recorded during the fieldwork; altered after (al-Jahwari 2013a: figures 1, 4)

A database of the Hafit tombs recorded during the project — representing hundreds of hours of ground-based survey — was very kindly made available to the author by al-Jahwari. This is the control dataset that was compared to the results of the Google Earth survey, allowing the efficacy of the remote sensing method to be assessed.

3.3 Method

Google Earth was used to survey the SQU study area for Hafit tombs remotely. The methodology was adapted from an approach already published by the author (Deadman 2012a). The precise boundaries of the study area were provided by al-Jahwari and were displayed in Google Earth to define the limits of the survey. The **Historical Imagery Tool** was used throughout the survey, so that the highest resolution and clearest imagery was used for every part of the study area (often **DigitalGlobe** imagery from 2009). The Google Earth grid was used and the remote sensing survey was carried out so that the width of the smallest square — 12 arcseconds or approximately 370m at this latitude — filled a 33cm wide computer screen, ensuring consistency in resolution during the survey. At this level of magnification an average-sized Hafit tomb is comfortably visible in satellite imagery. The window was moved steadily north-south along each column of the grid within the study area, and the location of possible Hafit tombs was recorded with **placemarks**. The survey was carried out 'blind' — without reference to the SQU results — and took approximately 20 hours to complete.

Comparisons were then drawn between the remote sensing and fieldwork-based datasets in order to assess the Google Earth methodology. For this purpose a distinction is made between accuracy and precision: for the purposes of this research, 'accuracy' is defined as a qualitative measure of the proportion of the features that were correctly identified as Hafit tombs with Google Earth; while 'precision' quantifies the proportion of the tombs present on the ground that were located with Google Earth. Thus, accurate survey distinguishes Hafit tombs from similar-looking features on the Google Earth satellite imagery such as trees, piles of rubble or other archaeological structures; while precise survey locates a high proportion of the Hafit tombs known to be present on the ground with Google Earth.

The accuracy of the Google Earth survey was assessed in three different ways. Firstly, a simple map of the results was visually compared to that of the SQU survey Hafit tomb distribution[1].

Secondly, density plots of the SQU survey Hafit tombs and the suspected Google Earth tombs were generated and compared. A black 'footprint' of each of the two density plots was also created to aid the comparison[2].

[1] the Google Earth **KML** data was converted into a **shapefile** and imported into ArcGIS alongside the SQU dataset and against the backdrop of a satellite imagery **basemap**

[2] the ArcGIS **Point Density Tool** was used on both datasets at a radius of 500m — an arbitary distance selected as the clearest through trial and error — while the 'footprints' were created using the **Buffer Tool** on each of the tomb datasets with the same 500m radius

Finally, a 1km grid was used to compare the two sets of results. The grid was generated to cover the whole of the study area and the number of SQU tombs and Google Earth tombs present in each square was counted, and the two plots were then compared[3].

Although involving a degree of error and uncertainty, the precision of the Google Earth survey was calculated — identifying the proportion of Hafit tombs that were located in both surveys. However, the accuracy of the GPS coordinates of the Hafit tombs in both datasets is innately imperfect, making it difficult to match individual tombs from the SQU survey to the corresponding features from the Google Earth survey. Coordinates were taken by the SQU team with handheld Garmin GPS units which are accurate to within 15 metres approximately 95% of the time (Garmin 2005). Likewise, the georectification and mosaicking of the satellite imagery in Google Earth is not perfectly accurate; a recent study calculated that to two standard deviations (95.45%) the coordinates of the imagery was out on average by 15.4 metres (Ubukawa et al. 2014: table 2). Thus the GPS and Google Earth coordinates for the same Hafit tomb could be 30.4m apart. Automatically matching tombs in the two datasets is problematic as: 1) the distance between neighbouring Hafit tombs is frequently less than 30.4m, 2) these errors are only measured to 95% probability, and 3) the error is random rather than stratified. As it is not possible to remove or reduce the error, it must be acknowledged and taken into consideration when matching the datasets and calculating the precision of the Google Earth survey. To match the Hafit tombs of the SQU and Google Earth surveys, coordinates of the two datasets within 30.4m of each other were automatically paired and from then considered to be the same tomb[4]. By comparing the number of matches to the total number of SQU Hafit tombs and Google Earth tombs, an estimate of the precision of the remote sensing survey was calculated. Furthermore, by comparing the condition of the SQU tombs recorded on the database that had a matching Google Earth tomb with that of the tombs that did not, the effect that this had on the visibility of the tombs on Google Earth was assessed.

3.4 Results

In total 2,667 suspected Hafit tombs were identified on Google Earth. As 4,992 were recorded by the SQU team, clearly Google Earth survey does not yield results as thorough and meticulous as ground-based fieldwork. To gauge the accuracy and precision of the methodology in detail, the two datasets were compared more closely.

[3]the ArcGIS **Create Fishnet Tool** was used to create the grid, the tombs were counted using the **Spatial Joint Tool** — joining each dataset to the grid square polygons, and the 'footprints' were generated by using the **Dissolve Tool** to merge each of the squares containing tombs into a single polygon

[4]the ArcGIS **Near Tool** was used to measure the distance between each Google Earth feature and the nearest SQU Hafit tomb, those within 30.4m of each other were paired as matches

There are distinct similarities in the distribution of the two datasets (Figure 3.2), the major difference being the number of the tombs rather than their location. This suggests that while not every Hafit tomb was visible on the satellite imagery, very few features were mistakenly identified as Hafit tombs on Google Earth.

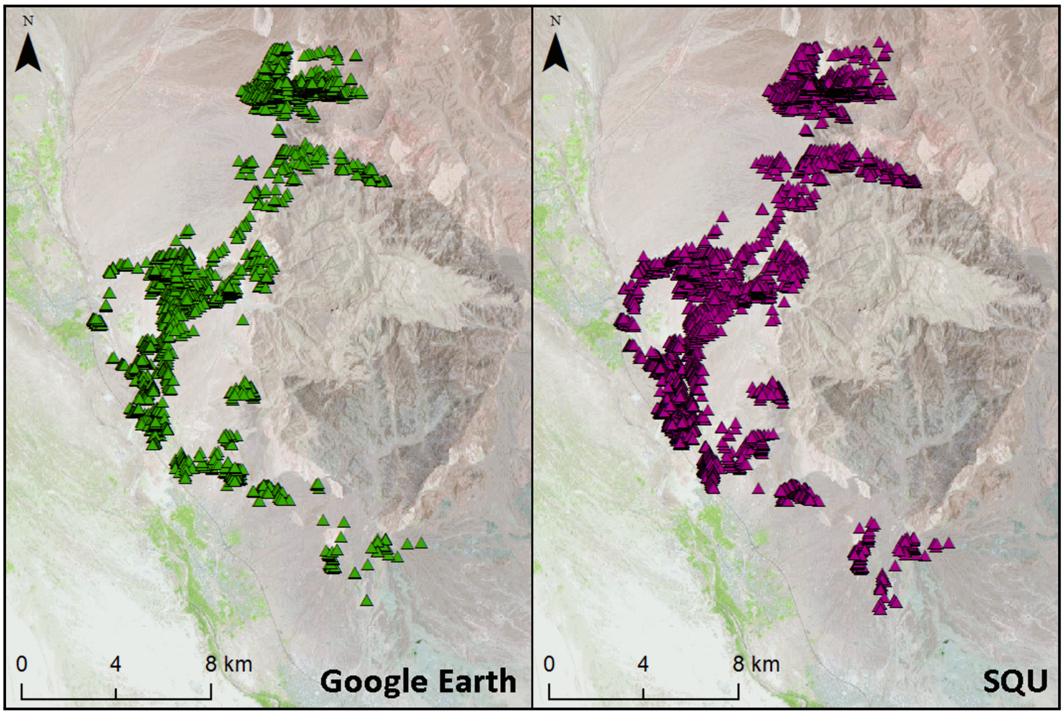


Figure 3.2: Features located on satellite imagery on Google Earth, and Hafit tombs recorded during the SQU survey

The density plots generated for the two datasets are similar — areas of high and low tomb density generally correspond (Figure 3.3). There are three major differences between the plots: 1) The density of the remotely sensed features is consistently and proportionally lower across the whole of the study area — consistent with the lower number of tombs being located on Google Earth. 2) The geographic extent of Hafit cemeteries are often smaller in the remotely sensed dataset — the result of tombs being missed in the periphery of Hafit cemeteries where tomb density is lower. 3) Lastly, there are four locations where suspected tombs located with Google Earth do not correspond to Hafit tombs recorded on the ground, these will be discussed later.

The low and high density squares of the gridded tomb count plots also generally correspond relatively (Figure 3.4). In some of the low-density peripheral areas Hafit tombs located by the SQU team were not visible on Google Earth. Similar to the density plots, suspected Hafit tombs were located with Google Earth in three grid squares that were devoid of Hafit tombs recorded by the SQU survey.

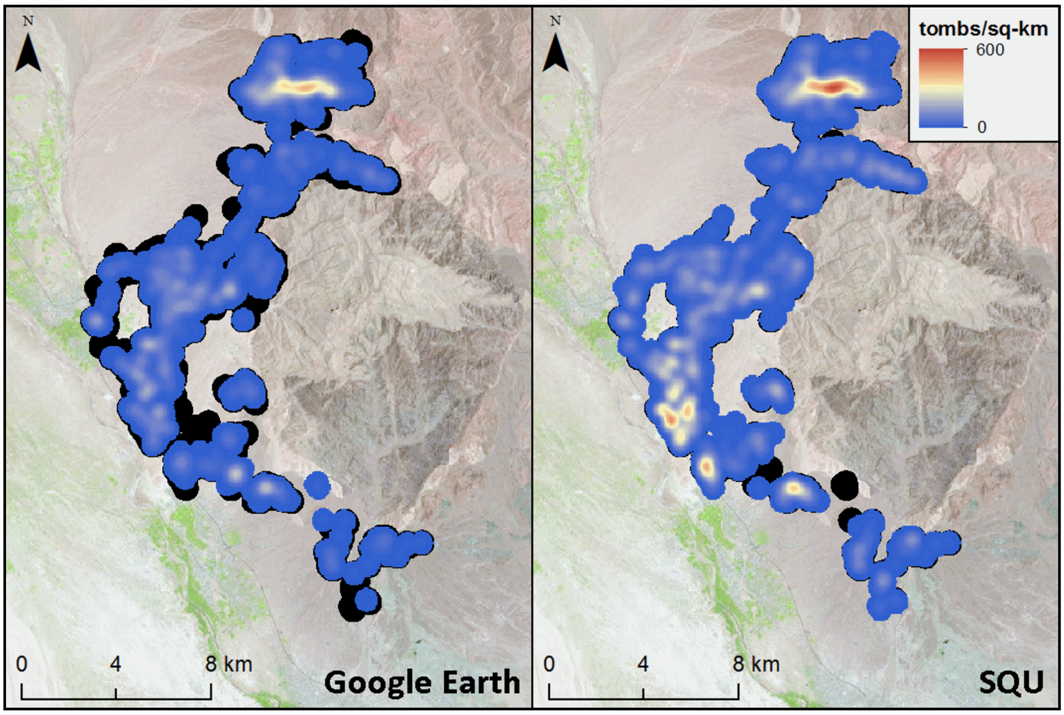


Figure 3.3: Density of features located on satellite imagery in Google Earth, and Hafit tombs recorded during the SQU survey, with black 'footprints' of the other plot displayed behind

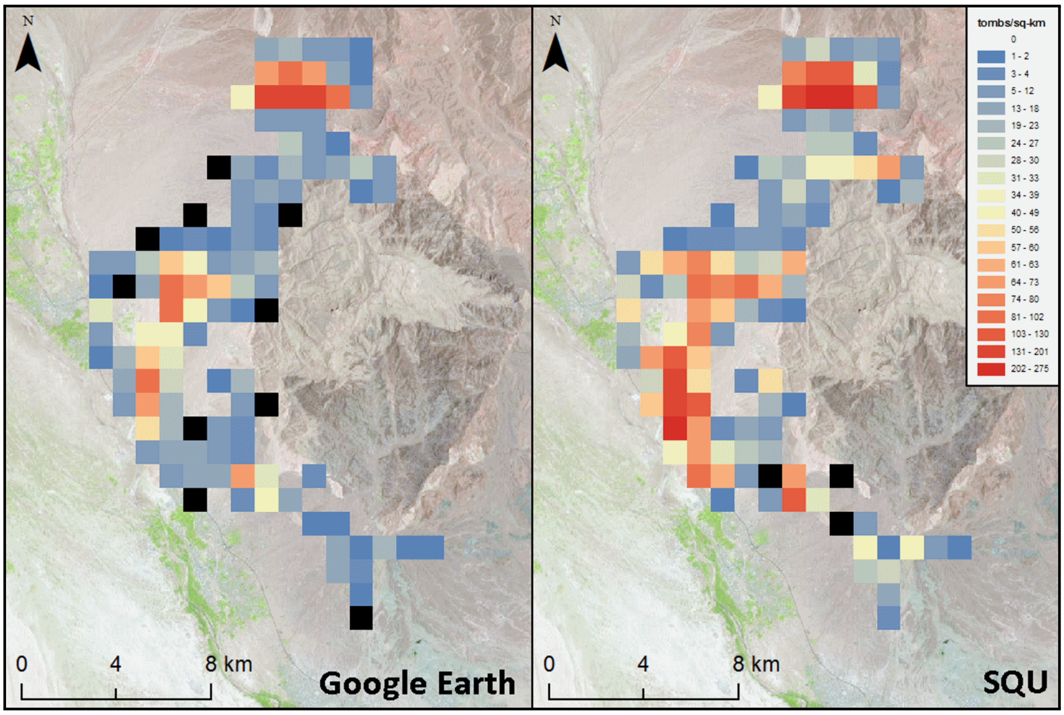


Figure 3.4: 1km gridded count of features located on satellite imagery in Google Earth, and Hafit tombs recorded during the SQU survey, with black 'footprints' of the other plot displayed behind

These four areas — or three grid squares — contain a total of 167 suspected Hafit tombs that were identified solely with Google Earth, and therefore have potentially serious ramifications for the overall accuracy of the Google Earth survey. The majority of these suspected tombs form a single cluster on an elevated area above a major wadi — on Google Earth they appear identical to other neighbouring tombs that were recorded by the SQU team (Figure 3.5); it seems most like that these are Hafit tombs that were missed by the SQU survey. The situation is similar at the three other sites. Clearly either a small number of Hafit tombs, representing a tiny percentage of the total population of the study area, were missed by the SQU survey, or these features look very similar to Hafit tombs on Google Earth but in reality date to a different period. The fact that these features are not scattered across the area as a whole, but are concentrated in a very small number of discrete clusters strongly suggests that the former explanation is more likely.

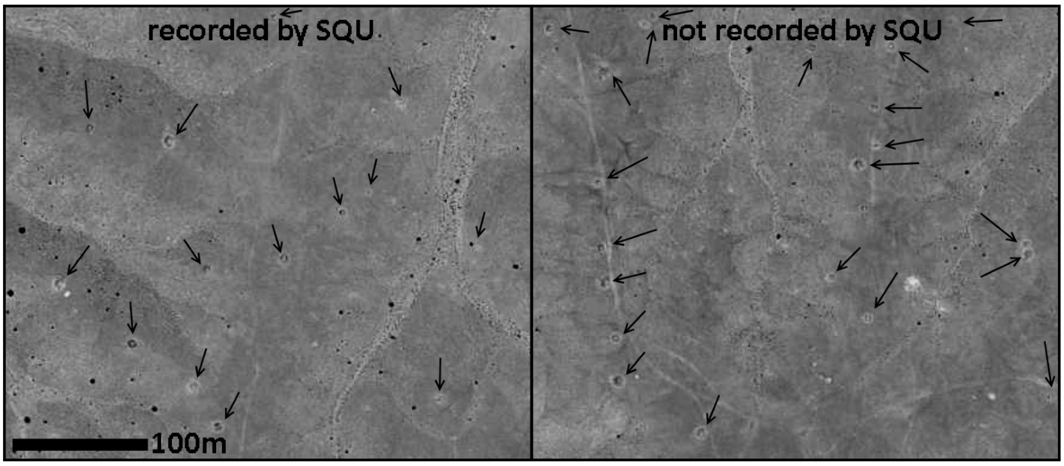


Figure 3.5: The Hafit tombs on the left were recorded by SQU, while some very similar features on the right ~250 metres away were not and seem to have been missed

It is not possible to calculate a numerical value of the accuracy of the Google Earth survey, but by comparing the distribution of the results of both surveys it is possible to gauge the accuracy of the method qualitatively. The very similar distribution of the tombs in the two datasets and the close correspondence of their density plots suggest that Hafit tombs can be accurately identified with Google Earth. If other features were consistently misidentified as Hafit tombs, there would have been large numbers of suspected tombs identified on Google Earth that had no corresponding feature from the SQU survey. This was not the case, instead the small number of discrepancies between the two datasets are more likely to identify errors made during the SQU survey than in the Google Earth survey. Clearly for the most part it is possible to identify Hafit tombs accurately using Google Earth's high resolution satellite imagery.

The precision of the Google Earth survey — the proportion of the total population of Hafit tombs successfully located on the satellite imagery — can be quantified, although the inherent inaccuracies involved need to be borne in mind. The location of 2,500 suspected Google Earth tombs were each matched with one of the 4,992 Hafit tombs from the SQU survey records[5] (Figure 3.6, Table 3.1). Therefore, just over 50% of the Hafit tombs known in the area were successfully located with Google Earth.

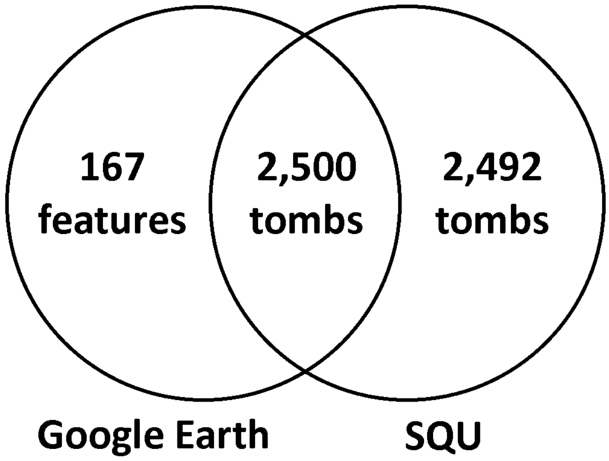


Figure 3.6: Numbers of matched and unmatched Google Earth features and SQU Hafit tombs

Table 3.1: The number of Google Earth features matched and not matched to SQU Hafit tombs

Distance $\leq$ 30.4m	Distance $>$ 30.4m	TOTAL
2,500 (94%)	167 (6%)	2,667

A comparison of the characteristics of the SQU Hafit tombs that were and were not located with Google Earth explains why some tombs were not visible. The condition of these two groups of Hafit tombs varies significantly (Figure 3.7) — the proportion of ruined structures was much higher in the tombs not located with Google Earth, than in those that were. Approximately 80% of the tombs classed as having 'very good' and 'good' preservation by the SQU team were located with Google Earth, while only ~40% of 'ruined' tombs were visible[6]. A Chi-Squared test confirmed a clearly significant statistical difference in the observed and expected condition of the matched tombs based on the SQU data. This strong correlation between tomb visibility on satellite imagery and the condition of the structures is striking given the inherent inaccuracies of matching

[5]twenty tombs were missing from the SQU survey database based on the published total of 5,012 Hafit tombs

[6]for precise definitions of these terms see al-Jahwari (2013a: table 2)

the SQU tombs and the Google Earth tombs. In reality the correlation is probably even stronger, with the numbers being weakened by occasional inaccurate matching of the more numerous ruined structures with Google Earth tombs, instead of nearby 'good' or 'very good' tombs, because of the combined 30.4m error in their coordinates.

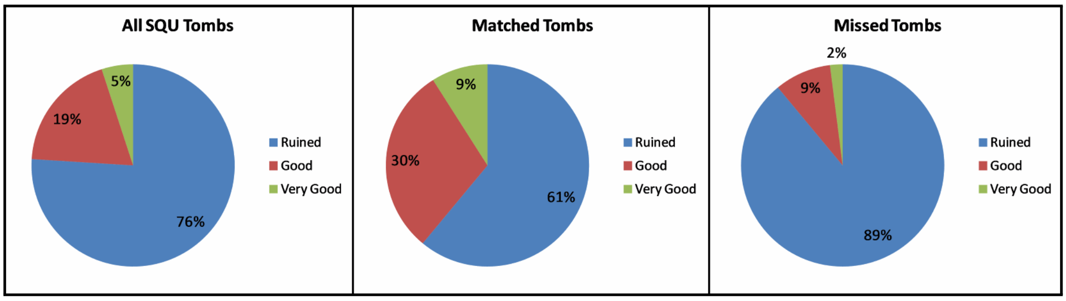


Figure 3.7: Difference in preservation between all SQU Hafit tombs, matched tombs and tombs missed during the Google Earth survey

3.5 Discussion

An assessment of the efficacy of Google Earth survey of Hafit tombs has clear ramifications for this thesis. Based on these results Google Earth cannot entirely replace ground-based survey of Hafit cemeteries — half of the tombs, particularly the less well preserved structures, would be missed, generating an incomplete record of a site. However, there is much to recommend Google Earth as a preliminary survey tool. In the survey of this area half of the Hafit tombs recorded over the course of a three-year fully funded SQU project — representing hundreds of hours of manual labour — were located remotely, over a period of twenty hours and at no cost. The distribution and relative density of the Google Earth tombs closely matched that of the SQU tombs. This suggests that Google Earth may be employed in more general studies examining the distribution of Hafit tombs over a wide area and the use of the landscape by Hafit populations. Hafit tombs located in this way form a large sample, rather than a complete population, but as long as the inherent biases in the sampling are understood, it will still be possible to understand the distribution of the tombs as a whole. The visibility of Hafit tombs on Google Earth appears to be largely dependent on their condition; although this is not entirely random — being to some extent dependent on the distribution of modern settlements and infrastructure within the landscape — it involves much less bias than if another variable, such as topography or geology, were the key factor. While the sampling of a Hafit tomb population through Google Earth survey will be largely representative, the major biases involved in the condition of the tombs need to be understood and taken into account when analysing the results.

This research shapes the thesis as a whole, determining the approach to be taken in the following chapters. Clearly Google Earth survey cannot be employed in isolation, which is why ground-truthing fieldwork is employed in the survey of the Batinah (Chapter 5.2.1, 5.3.1), and why ground survey is used to examine three Hafit cemetery case studies to complement the remote sensing research (Chapter 6). This chapter's findings also have more specific ramifications, for example allowances for the precision of Google Earth survey are made in estimating the number of surviving Hafit tombs across the northern Oman Peninsula (Chapter 4.4).

3.6 Conclusion

This chapter makes use of a meticulously collected ground-survey dataset of thousands of Hafit tombs to test the efficacy of Google Earth survey of the funerary structures. The results of an SQU survey — which over three seasons mapped the archaeology of a small study area in western Ja'alan, northeastern Oman — were kindly made available by Nasser al-Jahwari. 2,667 possible Hafit tombs were mapped on Google Earth within the SQU study area, moving north-south along the native grid and making use of the software's **Historical Imagery Tool** to use the clearest satellite imagery throughout the survey. This method was highly accurate, with the distribution and relative density of the tombs closely matching the SQU control dataset. What inaccuracies there were in the results were most likely due to a very small number of tombs being missed during the SQU survey. Approximately 50% of the SQU Hafit tombs were located with Google Earth, with the condition of the tombs an important factor in their visibility on satellite imagery. A high level of accuracy, and a 50% rate of precision demonstrates that Google Earth cannot entirely replace fieldwork, but that it can be used to great effect — extremely rapidly and at almost no expense — in preliminary surveys, and in general studies seeking to understand the distribution of Hafit tombs in the landscape. These findings have shaped the approach to be taken in following chapters. The results of this research form an important part of the discussion of the overall reliability of Google Earth to map Hafit tomb distributions in the thesis as a whole in the following chapter (Chapter 4.2).

Having evaluated the strengths and limitations of the core method of data collection in this thesis, Google Earth will now be employed, alongside complementary fieldwork, to map the distribution of Hafit tombs in the northern Oman Peninsula and in the Batinah region.

Chapter 4

Mapping and analysing the relative density and ubiquity of Hafit tombs across the northern Oman Peninsula

4.1 Introduction

A significant number of Hafit tombs has been excavated and they are almost ubiquitous in archaeological surveys (Chapter 1.1.2), yet very little is known about their relative density across the northern Oman Peninsula. An accurate map of their distribution across the region would make an invaluable tool, capable of shedding considerable light on the social, political and economical organisation of Hafit society. The map of Early Bronze Age sites in Cleuziou and Tosi's summary of the pre-Islamic archaeology of the region is the most comprehensive published example (Cleuziou and Tosi 2007: figure 92), marking the location of only 35 Hafit burial sites (Figure 4.1). By mapping the location of known Hafit tomb sites from the literature (Appendix A.1), a much more complete picture of the distribution of Hafit tombs may be generated (Figure 4.2). In some cases this reveals the presence of tombs in entirely new areas, especially in the northern and western emirates, but for the most part the two maps are very similar. Both have underlying issues: they depict a plethora of sites in the interior of Oman on the southwestern side of the Hajar Mountains, especially an inordinate number in eastern Sharqiyah; while very few sites are present in the eastern emirates, Musandam, and the Batinah. Such an unequal distribution suggests a research bias favouring certain areas, making the maps incomplete and inaccurate representations of Hafit tomb distribution.

Clearly a more comprehensive dataset is required to map the distribution of Hafit tombs accurately across the northern Oman Peninsula as a whole. This chapter presents the details of a Google Earth survey of Hafit tomb distribution that encompasses the

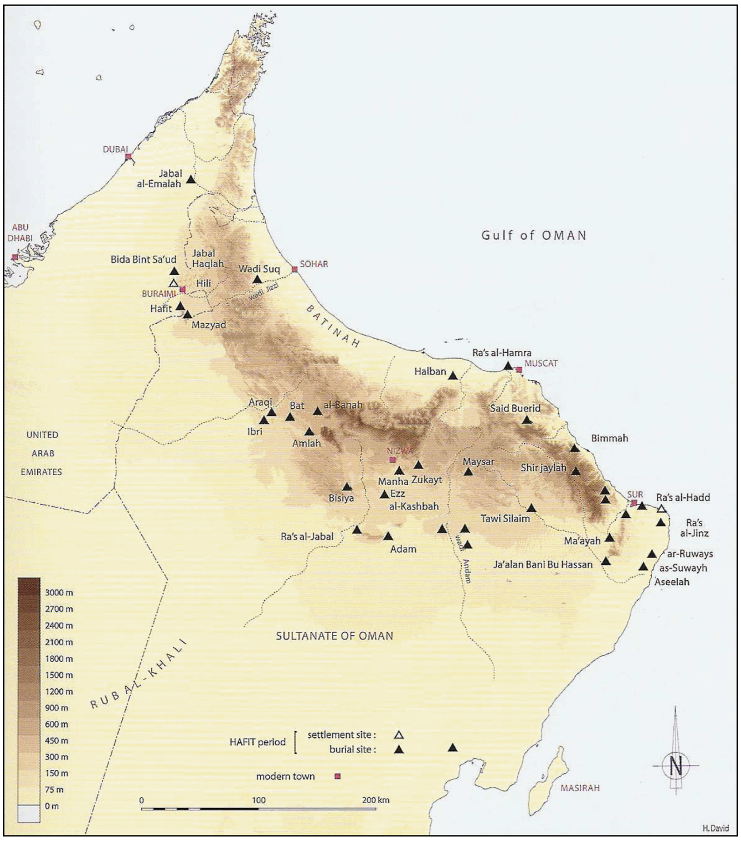


Figure 4.1: Altered version of Cleuiouz and Tosi's map, the most complete illustration of the distribution of Hafit sites in the literature (2007: figure 92, non-Hafit sites removed)

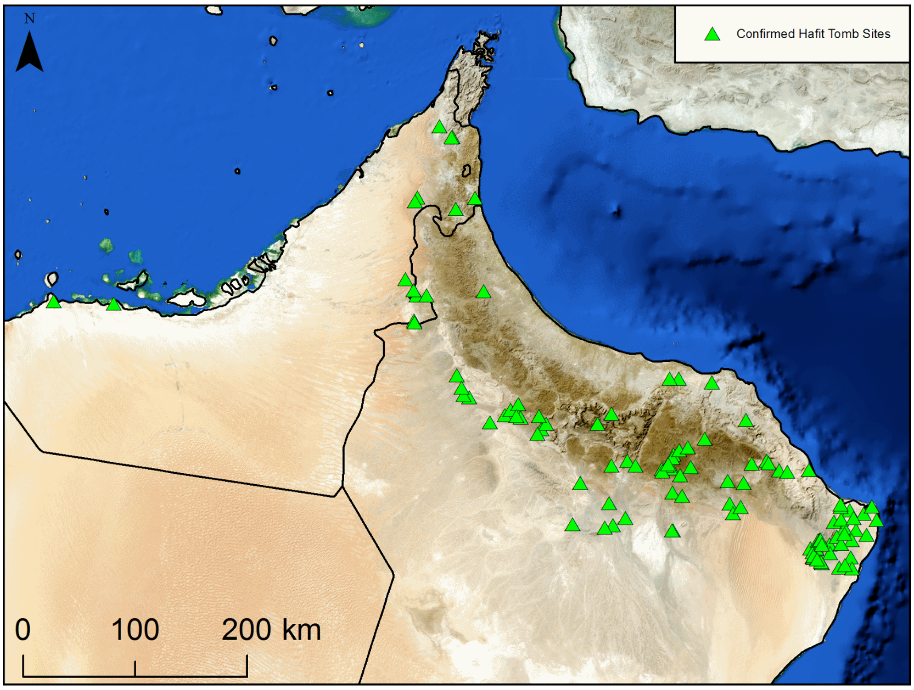


Figure 4.2: Map of known Hafit tomb sites in the literature (see Appendix A.1)

majority of the northern Oman Peninsula, aiming to generate such a dataset. Two major challenges must be faced in this endeavour: the huge surface area to be covered; and the accurate identification of Hafit tombs. Hafit tombs have been reported from the easternmost point of Oman at Ra's al Jinz to the western part of the emirate of Abu Dhabi, and from Ras al Khaimah to southern Ja'alan. Burial 'cairns' have been reported even further south, along a lengthy expanse of the eastern coast of Oman (Biagi 1988). The total extent of this range measures 750x850km, an area that realistically is many times too large to survey. By confining the study area to where the presence of Hafit tombs has been concretely confirmed (ignoring the 'possible' records), and Hafit tombs have been reported in considerable numbers, the study area may be drastically reduced. The vast majority of confirmed reports of Hafit tombs are restricted to the uplands and foothills of the Hajar Mountains; by concentrating on this area only two known Hafit tomb sites are excluded in a 350km expanse westwards of the mountain range — the survey area is reduced by a third by excluding less than 2% of known Hafit sites. It is further justified by the fact that the tombs at these sites were described as 'transitional' structures between Hafit and Umm an-Nar tombs, and contained pottery consistent with this date (Vogt, Gockel, et al. 1989: 54–56). Thus, the study area to be surveyed runs from the northernmost point of Musandam, sweeps south along the curving range of the Hajar Mountains — avoiding the Wahiba Sands desert — to Ra's Jibsh in Sharqiyah, 130km southwards along the coast from the easternmost extent of Oman (Figure 4.3). This area is much smaller than the extent of confirmed and possible Hafit tombs, but nevertheless is a huge expanse that encompasses over 98% of all known Hafit tomb sites and includes the entirety of the uplands and foothills of the Hajar Mountains.

The area to be covered by the survey is formidable — approximately 81,000 sq-km. Hafit tombs are only reliably visible with Google Earth's maximum-resolution satellite imagery. The largest area which may be viewed at this level of magnification using a standard desktop computer screen is approximately 750x450m — just over a third of a square kilometre. Thus, mapping every visible Hafit tomb would require the careful examination of nearly 250,000 computer screens of satellite imagery, taking thousands of hours. Clearly a tomb-by-tomb survey of the study area is far beyond the scope of this thesis. Instead, by dividing the area into large grid squares, and qualitatively assessing the density and ubiquity of Hafit tombs in each, a distribution map will be generated that is far superior to anything currently available in terms of accuracy, coverage and consistency.

A clear grasp of the geographic extent of tomb distribution, the relative density of the tombs, and the relationship between regional geography and tomb distribution are all fundamental if we wish to have a better understanding of where, how and why Hafit tombs are located in the northern Oman Peninsula, and what their distribution may reveal about Hafit society. By quantifying samples of the qualitative data it will be possible to estimate

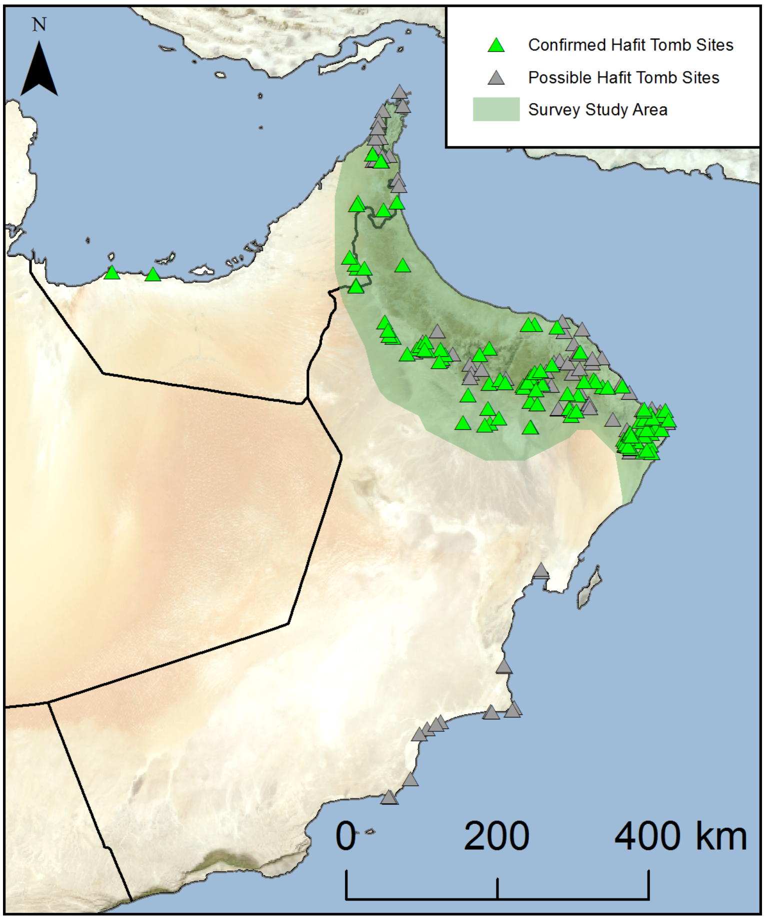


Figure 4.3: Survey study area and the distribution of confirmed and possible Hafit tomb sites (see Appendix A.1)

the number of Hafit tombs in the study area, and therefore also the size and density of the contemporary living population. The results will also provide an accurate and consistent picture of Hafit tomb distribution that may be compared to research specifically examining the Batinah's funerary archaeology in later chapters. Undoubtedly, this analysis will be imprecise, but nevertheless it is worth carrying out in order to identify and examine the general trends of Hafit tomb distribution. The results of this new survey methodology cannot identify or describe in detail the factors that influenced Hafit society, but they should provide a useful starting point against which to compare a more detailed, localised analysis of the Batinah.

The chapter therefore has three objectives: 1) so far as is possible, to survey the density and ubiquity of Hafit tombs across the northern Oman peninsula study area; 2) to calculate an estimate for the total number of Hafit tombs that survive, and estimate the size and density of the contemporary population; and 3) to apply GIS analysis to model the environmental and anthropogenic factors that may have affected the distribution of Hafit tombs at the broader regional level, as well as at a small-scale landscape level.

However, before presenting the findings of the northern Oman Peninsula Google Earth (NOP-GE) survey, the second major challenge involved in this endeavour must be considered — the reliability of using Google Earth to locate and identify Hafit tombs.

4.2 Assessing the reliability of identifying Hafit tombs in Google Earth

Before going any further, there is one key point that must be addressed that is fundamental to the thesis as a whole and which requires the discussion of methodology, data and analysis from later chapters. Remote sensing survey using high-resolution satellite imagery in Google Earth forms the basis of most of the data collection in this thesis. Being able to identify Hafit tombs reliably and accurately and to distinguish them from other archaeological remains, including the stone tombs of other periods, is therefore absolutely critical — if this is not possible then the conclusions regarding the nature of Hafit society drawn from the data are not reliable. It is therefore clearly necessary to evaluate the evidence for the reliability of Google Earth data collected at various stages throughout the thesis and evaluate its trustworthiness.

But why is it necessary to turn to remote sensing at all? Our knowledge of the funerary archaeology of the northern Oman Peninsula is far from complete — classifying and dating stone tombs on the ground is already a challenge, why exacerbate such problems through the use of satellite imagery? The answer is that while there will be data-quality issues with such an approach, it is vital that ambitious steps are taken at this stage to interrogate the formidable funerary datasets of the region, otherwise progress in getting to grips with this key archaeological dataset will be stifled. Fifty years of multi-period surveys (e.g. Schreiber and Häser 2004) and occasional excavations of Hafit tombs (e.g. Salvatori 2001) have clearly not served to advance our understanding of the Hafit funerary dataset or Hafit society at any great pace and neither has novel, sophisticated analysis of Early Bronze Age tomb architecture (Bortolini 2012; 2009). A bold new approach is needed to tackle Hafit tombs (and other stone monuments) that collects and analyses funerary data at a much greater scale if any progress is to be made in moving our understanding forward. The data is certainly not perfect and conclusions will certainly need to be updated and revised in the light of future work and discoveries, but to advance our knowledge substantively bold, broad and ambitious methods are clearly necessary at this juncture. It is also important to underline the key role that ground-truthing must play in remote-sensing — any identification of archaeological sites without it can only be provisional.

Furthermore, before remote sensing-based methodology is to be applied to the Hafit dataset two fundamental questions must be answered: 1) is it possible to identify Hafit tombs from Google Earth, and if so how accurately?, and 2) is it possible to distinguish between Hafit tombs and similar tombs of other periods using Google Earth, and if so how reliably? However, before remote sensing data is even considered, we need to agree what is meant by 'Hafit tomb' and how we distinguish such from similar structures on the ground.

4.2.1 Hafit tombs and other stone tomb types

Two common Later Prehistoric Tomb (LPT) types often occur in similar areas to Hafit tombs and, with broadly similar aspects, may be mistaken for them: 'Cell Graves' and 'Honeycomb Tombs' (Chapter 5.2.3, 5.3.3). Other stone tomb and grave types are known — such as 4th millennium BC pit graves (Salvatori 2007), single Wadi Suq tombs (Frifelt 1975b), and Samad cists (Yule 2001) — but these are mostly or fully subterranean and are not generally easily confused with Hafit tombs on the ground, so these will not be discussed here. In the discussion below, background information and the available dating evidence for Cell Graves and Honeycomb Tombs will be presented[1], before the architectural criteria that were used to distinguish between them and Hafit tombs on the ground are set out, but first the main architectural characteristics of Hafit tombs are briefly reviewed.

Hafit tombs

Hafit tomb architecture is reviewed in detail at the start of the thesis (Chapter 1.1.2). In summary, these are detached, roughly circular tombs with a central, single, circular or oval corbelled chamber, accessed in most cases through a small rectangular, triangular or trapezoidal entrance (Figure 4.4). They are usually between five and seven metres in diameter, but can be larger or smaller than this, to a maximum of 9–10m and a minimum of 3m. They are constructed from at least one double, drystone wall of unworked stones; the outer wall is smoothly faced due to the careful selection and laying of the stones and the void in between the two faces is packed with rubble. The wall is carefully corbelled inwards to form a false dome, giving the tombs a curved, beehive-like profile. In most cases one or more additional ringwalls is added to this basic structure — further smooth

[1]Tomb typologies followed by the Dutch team working in part of North al-Batinah emerged following the completion of the present author's fieldwork (Düring and Olijdam 2015), it is clear from the text of the article and from detailed discussion with the first author that their 'dome-shaped cairns' are probably small, disturbed Hafit tombs and that their 'terraced cairns' equate to Cell Graves

faces and more rubble packing, giving the tombs a concentrically circular plan. They can be built of either angular slabs or rounded cobbles, depending on what local stone is available.

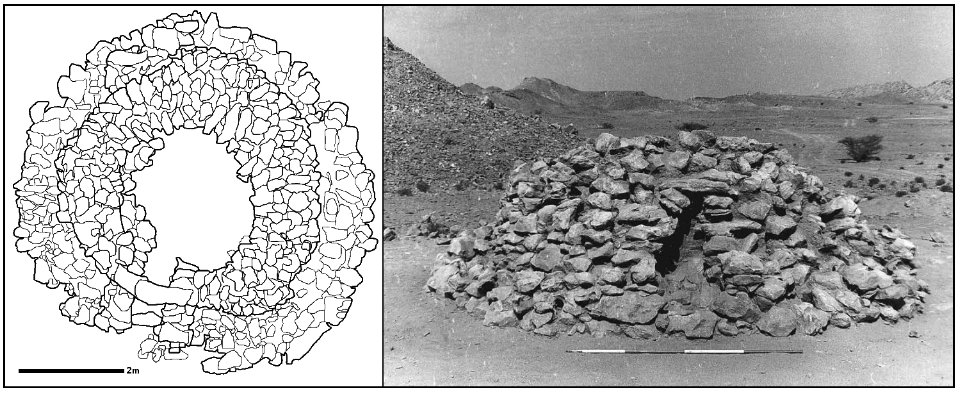


Figure 4.4: Typical Hafit tombs, Jebel Hafit (Cleuziou, Vogt, and Méry 2011: figs 14, 12)

Cell Graves

'Cell Graves' are very common in the Batinah and were first recorded there by the Danish team working in Wadi al-Jizzi during one of the first surveys of northern Oman (Frifelt 1975b). They are oval tombs with a double wall of stones and a gravel/small stone packing, surrounding a single oval chamber accessed through the roof; the outer wall is rough and unfaced and leans inwards only slightly, the inner wall is corbelled sharply to a gap that is bridged by stone slabs and then covered with more gravel/small stones to form a flat roof approximately 1m high (Figure 4.5). They can either be detached, freestanding structures or be agglomerated in groups of five or more with shared walls to form a single structure (Frifelt 1975b: 373). The Dutch team currently working in the same area refer to the structures as 'terraced tombs'; on average each tomb is around 4.5m long and 2.5m wide, but when grouped in clusters or rows much larger structures are formed (Düring and Olijdam 2015: 101). Identical tombs were recorded earlier by de Cardi, who refers to them as 'pill-box cairns', just beyond the very northern end of the Batinah plain near Kalba in the U.A.E. (de Cardi and Doe 1971: 241, 258), and further north in Musandam (de Cardi 1975: 22). Beyond the Batinah, an SQU survey of part of the Sharqiyah coast reports a large cluster of 'cairns' that exactly match the Cell Grave description: they are oval in shape, ~1m in height, and accessed through a central opening in the roof, covered with slabs. The illustrated example is 4x3m in size, and has a double wall of unworked stones, with the space in between packed with small stones (Ibrahim and ElMahi 2000: 123, fig. 4). In the same region the Oases of Oman project reported hundreds of very similar tombs in the hills around around Tiwi: a “round or oval double wall of large, irregular, corbelled stones” with “a roof of large, flat stones with small stones piled on top of them”, ranging from 1.8–4.6m long by 0.8–2.5m wide and 1.0–1.7m high (Schreiber and Häser 2004: 324; Korn et al. 2002: 14).

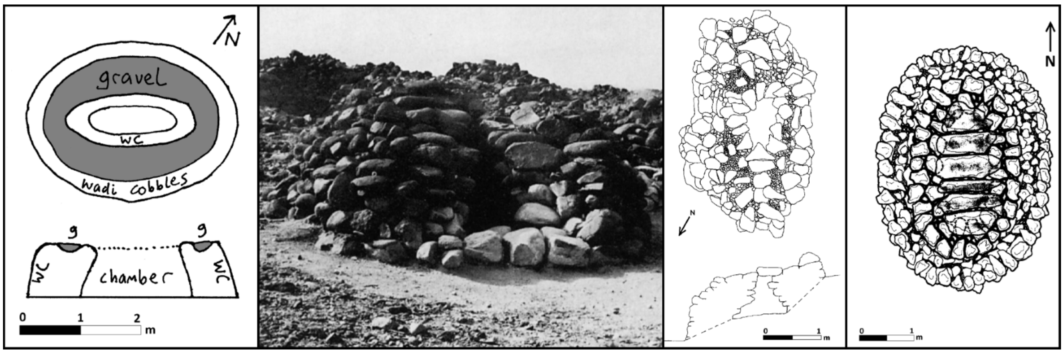


Figure 4.5: Cell Graves from the Batinah and Sharqiyah (author’s field sketch; Frifelt 1975b: fig. 62; Schreiber and Häser 2004: fig. 8; Ibrahim and ElMahi 2000: fig. 4)

Outside of the Batinah stone tombs have been recorded across the northern Oman Peninsula that are architecturally similar to Cell Graves, suggesting that they are probably related (Figure 4.6). The architecture of ‘pill-box’ tombs recorded by de Cardi on the southwestern side of the Hajar Mountains (de Cardi, Collier, et al. 1976; Doe 1977), and in Ras Al Khaimah (1985), differs from her earlier discoveries. The tombs are circular, oval, square or rectangular, many with apsidal ends, they are usually 0.5–1.5m high and are roofed with flat stones spanning the chamber; a typical tomb is 4x3m in size and 1.4m high, with a corbelled chamber, but the tombs also boasts a door with a lintel (de Cardi, Collier, et al. 1976: 148, fig. 28; Doe 1977: 36, fig. 77; de Cardi 1985: 190). Similar ‘*kastengrabes*’ (box graves) have been reported by the German Mission in Sharqiyah; rounded rectangles in plan, roofed with capstones and covered with gravel, and tightly clustered together in considerable numbers (Weisgerber 1980: 101, figs 71, 72). At Maysar-36 the ‘kastengrabes’ are either rectangular, circular or oval, and stand together in large groups on hill slopes — the team equated these structures to de Cardi’s ‘pill-box tombs’ (Weisgerber 1981: 183, 224–225; Yule and Weisgerber 1988: 14, 18). Similar structures were excavated later, a short distance away at Samad; these were disturbed sub-circular tombs with diameters of 2.5–4.5m, lacked an entrance, and were constructed with a double wall with a packing of small stones. Surveys in the same region reported what were now termed ‘hut graves’ — quadratic, circular, or hoof-shaped in plan, 1.7m high and 2x2m in size, with a double wall packed with gravel, and boasting an entrance — at Bilad al-Ma’din, Muqatta-Rawdah and Jebel Salayli (Yule and Kazenwadel 1993: 254; Yule, Weisgerber, et al. 1994: 396-398). Ruined hut graves were also reported in a much more mountainous part of Sharqiyah at Maqta’ah Hail (Yule and Weisgerber 1998: 210). The Oases of Oman project reports hut graves on the Saiq plateau in Jebel Akhder — in the mountains overlooking the Batinah, 2000m above sea level — that had been constructed from the stones of nearby Hafit tombs (Schreiber 2004a: 10, fig. 6).

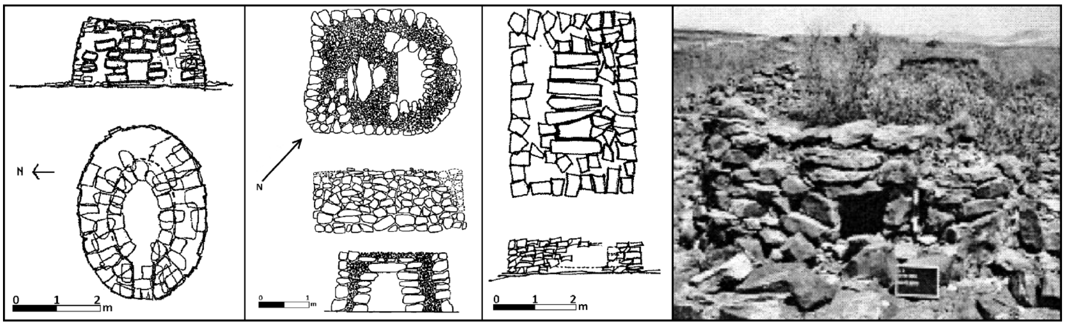


Figure 4.6: Hut graves and pill-box tombs show clear architectural similarities to Cell Graves (Doe 1977: fig. 13; Yule, Weisgerber, et al. 1994: plate 8; de Cardi, Collier, et al. 1976: fig. 28; Schreiber 2004a: fig. 6)

The dating evidence for Cell Graves is limited and varied, but certainly points to construction well after the Hafit period. The Danish team excavated seven of them in Wadi al-Jizzi, but they yielded relatively few finds including some that were clearly intrusive. The recovery of two iron finds, if forming part of the original inventory, strongly suggest a Late Iron Age date, Frifelt dates the Cell Graves to some point in the 1st millennium BC (Frifelt 1975b: 373). About a third of the 'type 2' tombs excavated recently in the Batinah, tentatively identified as Cell Graves, yielded Early Iron Age pottery (Saunders 2016: 166–167), but these are unusual and poorly preserved tombs and some or all may well be of a different type (discussed below). Based on the presence of Samad pottery observed around the large Cell Grave cemetery at Tiwi, the survey team date the tombs to the Late Iron Age, although none of the graves were excavated (Schreiber and Häser 2004: 325). Hut graves excavated at Samad and Maysar have yielded an Iron Age II (Lizq/Rumeilah) assemblage (Vogt 1984: 272; Weisgerber 1981: 183, 224–225; Yule and Weisgerber 1988: 14, 18), but these tombs show some architectural differences to Cell Graves. Currently unpublished survey and excavation evidence of Cell Graves in the northern part of Al-Batinah associates the tombs with Sasanian or even Early Islamic material including turquoise glazed pottery and other small finds (Bleda During, pers. comm.), although the Sasanian period in Eastern Arabia is an enigma that seems to be highly regionalised and difficult to understand (Kennet 2007). Although it is difficult to date Cell Graves definitively, excavation and survey data point to a period of construction sometime in the Early or Late Iron Age, but maybe as late as the Sasanian or very Early Islamic period.

Honeycomb Tombs

'Honeycomb Tombs' are found in much lower numbers than Cell Graves in the Batinah, but they are still fairly common; they were first reported by a joint Omani-German team during survey and excavations near Bawsher at the very eastern end of the Batinah plain (Yule 1999: 28–41). Honeycomb Tombs are low, crude stone tombs with multiple irregularly shaped chambers; the original Bawsher example consists of 65 wadi cobble units agglomerated into a single, massive, organic structure, with each individual unit defining the shape of a subterranean cist (Yule 1999: 28). Further excavations at the same site revealed three similar tombs with fewer than five chambers (al-Jahwari and ElMahi 2007: 12). During recent archaeological work ahead of the construction of Phase 3 of the Batinah Express Highway five Honeycomb Tombs were excavated across three sites within the *wilayat* of Suwayq and Khaburah (Saunders 2016). The number of chambers in the tombs vary — one five-, one four-, one three-, and two double-chambered — but they all show a simple construction, with differently sized rocks arranged simply into small, irregular chambers agglomerated into an organic shape. The largest measuring 11x5m and the others ~7x5–6m; unlike the Bawsher tombs most of the chambers were built directly onto the ground surface, with only some being subterranean, but still only reaching a maximum height of ~1m (Saunders 2016: 12). Beyond the Batinah, al-Jahwari excavated a Honeycomb Tomb at Ghoryeen in Sharqiyah, consisting of eight irregular, semi-subterranean chambers of varying size, crudely built of wadi cobbles and smaller stones, forming a round, organic tomb 8m in diameter (al-Jahwari 2010: 102).

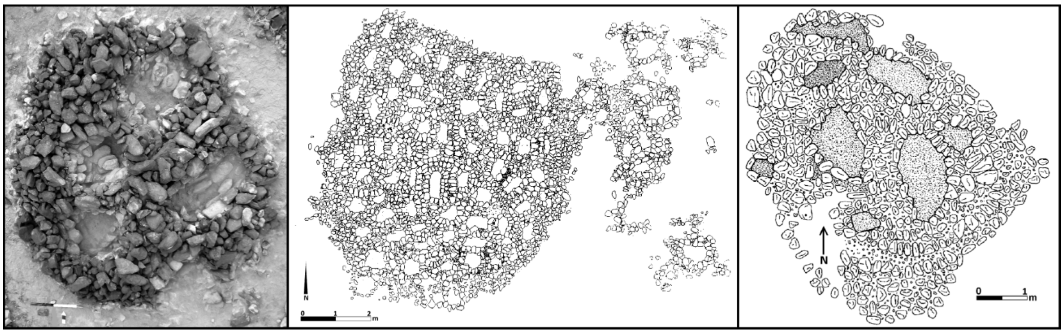


Figure 4.7: Honeycomb Tombs from the Batinah and Sharqiyah (Ben Saunders; Yule 1999: fig. 6; al-Jahwari 2010: fig. 9)

Like Cell Graves the precise date of the Honeycomb Tombs is uncertain, but the available evidence points to the Iron Age. The huge Bawsher Honeycomb yielded both Early and Late Iron Age grave goods (Yule 1999: 28–41, 70–72), while the smaller tombs yielded Late Iron Age material (al-Jahwari and ElMahi 2007: table 1). Prehistoric pottery was only recovered from one of the five Batinah Highway Honeycombs, and was dated to the Iron II period (Saunders 2016: 95–96, fig. 359). The Ghoryeen Honeycomb produced a small Iron II assemblage, including beads and a bronze arrowhead (al-Jahwari 2010: 102–104, fig. 10). The precise chronological and typological relationship between Cell Graves and Honeycomb Tombs is unclear — they do share some architectural features and both seem to have constructed at some point during the Iron Age, but this is far beyond the scope of this thesis.

Distinguishing stone tomb types on the ground

In all types of survey the tombs are categorised, and in the case of Hafit tombs therefore dated, on the basis of comparison with excavated examples from the literature. Categorising stone tombs on the ground is not always a straightforward process. Indeed, even after excavation classifying and dating the tombs may be difficult due to re-use, remodelling, the rapid deterioration of bone collagen, the paucity of grave goods, and the routine robbing of furnishings and masonry. However, for the most part it is possible to distinguish Hafit tombs from Cell Graves and Honeycomb Tombs. When Hafit tombs are well preserved they are very distinctive, but when they are collapsed it is more difficult to tell them from the other types (Figure 4.8). In this state their large size and circular shape help to set them apart, as does the large volume of fallen masonry. Even when collapsed it is usually possible to make out the round outline of a large, single chamber within the rubble. When they have been severely robbed of stone, usually having been quarried for later tombs nearby, it is often easier to identify them as their lowest course usually remains, embedded in the surface and providing a clear plan of the original structure. The categorisation process is provisional, and in some cases where the architecture is ambiguous — such as with larger, rounder Cell Graves, or small sub-circular Hafit tombs — the process is not always unproblematic or unambiguous. There is overlap in the dimensions between tombs types, and so size cannot alone be used to identify a tomb, it must be paired with other characteristics.

During fieldwork Cell Graves were found in considerable numbers right across the Batinah, being by far the most common non-Hafit stone tomb (Chapter 5.2.2, 5.3.2, 6.4.1). When they are well preserved they are easily distinguished from Hafit tombs: they are generally smaller in size; their walls are rough and unfaced; they are oval in plan rather than round; have only one double wall; have much straighter sides and a flat roof; reach a much lower height; have a highly distinctive gravel/small stone wall packing; and multiple units are often agglomerated into a single structure unlike detached Hafit tombs (Figure 4.9). When detached Cell Graves are in a disturbed condition distinguishing them from Hafit tombs can be more difficult: usually they retain their oval

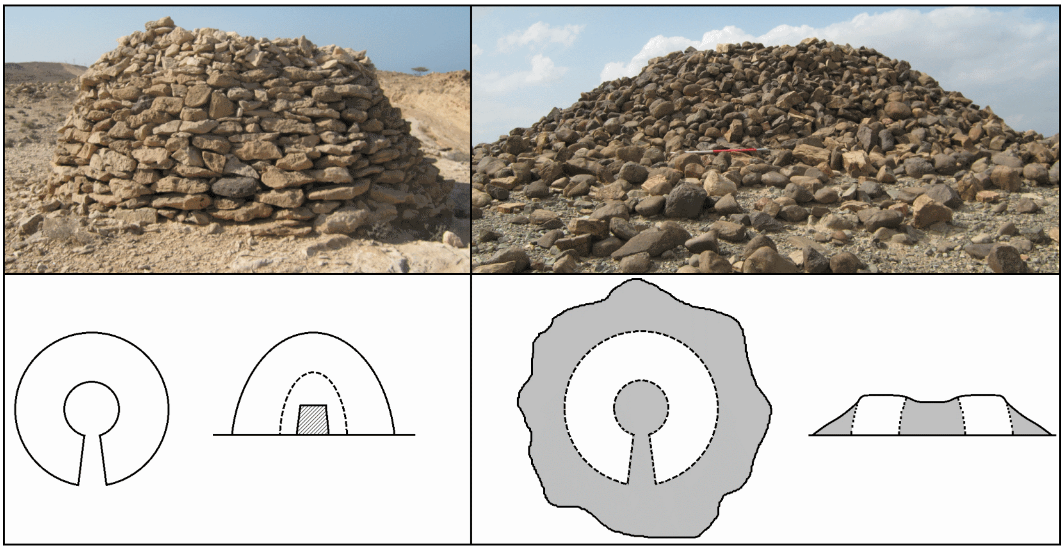


Figure 4.8: Hafit tombs in good and poor condition

shape; they boast a much lower volume of fallen masonry than the average Hafit tomb; and the distinctive gravel/small stone packing material is usually made more apparent on the surface by their collapse (Figure 4.10).

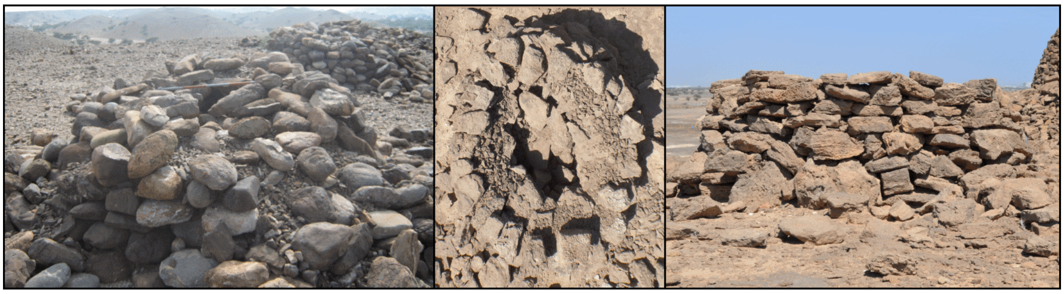


Figure 4.9: Distinctive Cell Grave architecture

A small but significant number of Honeycomb Tombs were observed during Batinah fieldwork (Chapter 5.2.2, 5.3.2). When in good condition they cannot be mistaken for Hafit tombs as their multiple chambers and agglomerated, irregular shape make them completely dissimilar. However, when they are in poor condition a small Honeycomb could be mistaken for a robbed Hafit tomb (Figure 4.11). They are usually less round than Hafit tombs; they have a much lower total volume of masonry; and this is looser in places and more undulating due to the multiple chambers; and the stone masonry is also usually a lot more mixed in terms of shape and size.

Although the dating of neither Cell Graves nor Honeycomb Tombs is clear — with an Iron Age date being the strongest possibility for both — they are clearly later than Hafit tombs as they are often found in good condition in close proximity to Hafit tombs that have been severely robbed of masonry, and sometimes Hafit tombs have been

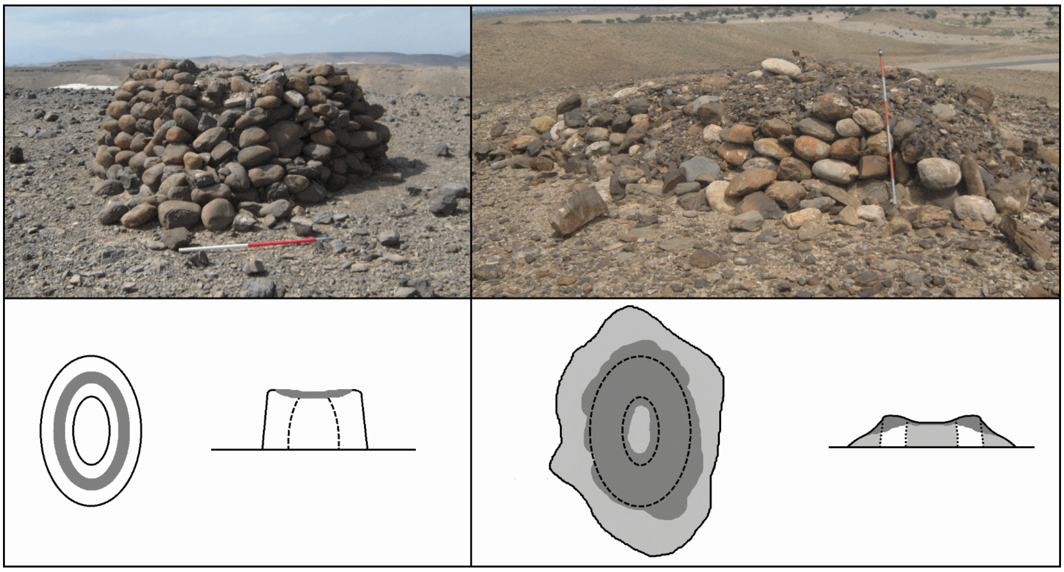


Figure 4.10: Cell Graves in good and poor condition

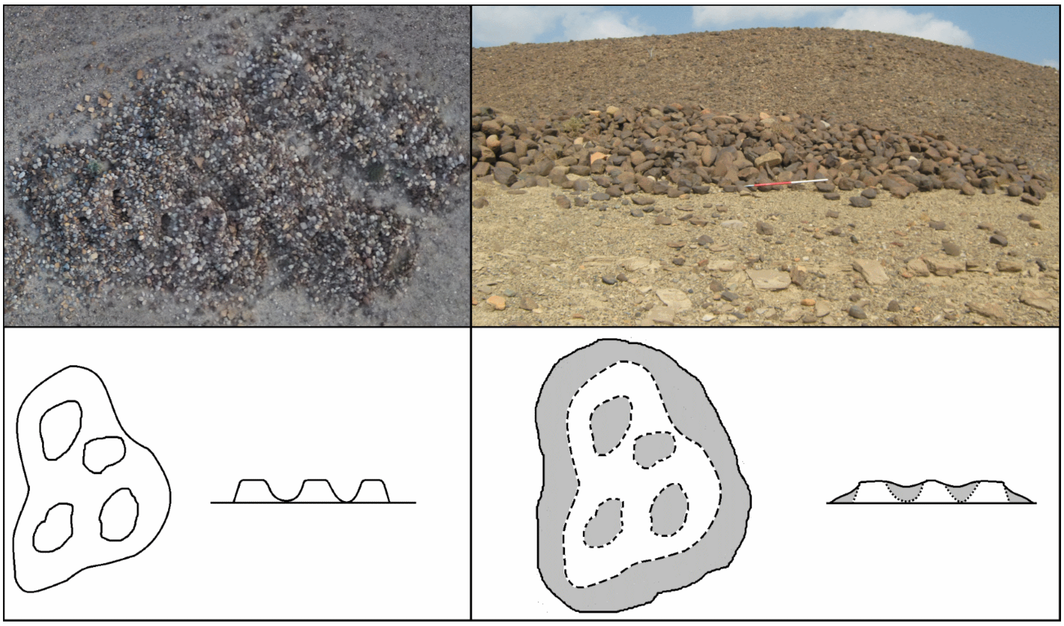


Figure 4.11: Honeycomb Tombs in good and poor condition

remodelled to resemble the two types (Chapter 5.2.3, 5.3.3). When they are well preserved it is relatively straightforward to distinguish the three types on the ground, but when they are disturbed classifying the tombs is more difficult and demands a good knowledge of the funerary archaeology of the region and experience in the field. Moreover, local preferences for certain building materials in certain types, and the context of other tombs within the same cemetery or the local landscape also informs tomb categorisation. To some extent, as with all field archaeology, this is an intuitive process, in which knowledge and experience are brought to bear to provide an instinctive identification in a process that is more profound than the mere application of criteria to a stone monument. Unfortunately, some tombs are just too badly disturbed to identify accurately. During ground-truthing of the second phase of the Batinah survey 66 tombs were recorded and six of these (9.1%) — four identified as Hafit tombs and two as LPTs on the imagery — were in too poor a condition to identify (Chapter 5.3.3). Thankfully, the proportion of unidentifiable tombs is sufficiently small as to not undermine data analysis — even if in these cases the chance of accurately distinguishing a Hafit tomb from another type is only 50%, misidentifications will still represent fewer than 5% of the Hafit dataset.

4.2.2 Identifying Hafit tombs in Google Earth

Having defined what does and does not constitute a Hafit tomb on the ground, it is necessary to consider the extent to which it is possible to identify these tombs on Google Earth. Chapter 3 describes a study designed to assess the 'accuracy' — the proportion of features correctly identified as Hafit tombs with satellite imagery — and the 'precision' — the proportion of Hafit tombs present on the ground that were visible on satellite imagery — of a Google Earth-based Hafit tomb survey using the records of meticulous ground-based fieldwork carried out by a Sultan Qaboos University (SQU) team in northeastern Oman. The SQU study area was scanned employing Google Earth's own 12 arcsecond grid and suspected Hafit tombs were located on the imagery and marked (Chapter 3.3). When compared to the SQU records, the rate of misidentification of Hafit tombs — in which natural features or other archaeological remains were mistaken for Hafit tombs on Google Earth — proved to be extremely low. The distribution of both datasets was very similar and of the 2,667 suspected Hafit tombs only 167 did not correspond to a tomb in the SQU dataset (~6.3%), but the majority of these appear to have been missed on the ground rather than misidentified on the imagery, suggesting that the accuracy of the survey method is greater than 95% (Chapter 3.4). This is consistent with the results of ground-truthing carried out during the Google Earth Batinah survey: of the 36 suspected Hafit cemeteries visited, none yielded no tombs at all (Chapter 5.2.2, 5.3.2).

However, clearly not every Hafit tomb is visible on Google Earth imagery. In the Chapter 3 study just over 50% of the SQU tombs were located in Google Earth; analysis of the ground survey records suggested that preservation is the primary factor that determines tomb visibility — a higher proportion of well-preserved tombs and a lower proportion of ruined structures were successfully located (Chapter 3.4). The Google Earth magnification level — i.e. the resolution of the imagery — also affects tomb visibility: during the Batinah Hafit tomb survey nearly 40% more tombs were located in the same area surveyed with a 12 arcsecond grid compared to a 1km grid (Chapter 5.3.3). Clearly Hafit tombs can be accurately identified in Google Earth and although not every tomb is visible on the satellite imagery, the use of a higher level of magnification will maximise the proportion that are located.

4.2.3 Distinguishing Hafit and non-Hafit tombs in Google Earth

A trickier problem is distinguishing Hafit tombs from Later Prehistoric Tombs (LPTs) — Cell Graves, Honeycomb Tombs and any other stone tombs constructed after the Hafit period — on satellite imagery. Success depends on the magnification of the satellite imagery, the condition of the tombs, and knowledge of the specific locality's funerary archaeology. In Chapter 5 the Batinah Google Earth (B-GE) survey is described, an effort to map the location of every visible Hafit tomb in the region using the software's high-resolution satellite imagery. As the Batinah is so large, covering a surface area of ~12,500 sq-km, the original 12 arcsecond methodology (Chapter 3) was adapted to cover ground more quickly — a larger 1km grid was used along with a wider computer screen (Chapter 5.2.1). When the 1km B-GE survey results were ground-truthed it was found that while Hafit cemeteries had not been missed, Hafit tombs could not be reliably distinguished from LPTs. While only one of the 18 (5.6%) suspected Hafit cemeteries visited was found to contain solely LPTs, a further four (22.2%) contained a greater number of LPTs than Hafit tombs (Chapter 5.2.2). In an attempt to improve reliability, areas in which tombs were found were resurveyed at a greater level of magnification using the 12 arcsecond grid and with the aid of a reference collection of satellite imagery of ground-truthed Hafit tomb and LPT cemeteries to help distinguish between the tombs. A greater total number of tombs was located in this second pass and the proportion of LPTs increased from under a third to over half of the total. The increased magnification made a substantial difference to tomb identification as it was then possible to distinguish genuine Hafit tombs from LPTs that merely appeared quite similar to Hafit tombs at the lower resolution of the 1km B-GE survey. When these findings were ground-truthed, of the 36 suspected Hafit tombs examined at 18 sites from across the Batinah, 32 were identified as Hafit or probably Hafit — based on the criteria outlined above — with the remaining four being too disturbed to identify, and none being Cell Graves, Honeycomb Tombs or any other LPTs. Of the 30 suspected LPTs examined across 16 sites, two were too disturbed to identify, and only one was identified as a Hafit tomb in the field and this had been drastically remodelled in a later period with an extra chamber added on to its side. Discounting the disturbed structures yields a success rate of 59/60 (98.3%). It must be stressed that this is a relatively small sample, dictated by the time and resources available to a single individual — as further surveys and excavations of Hafit tombs are carried out and published in the Batinah in the future the reliability of the methodology will become more clear.

Comparisons with early published excavation reports ahead of the construction of the Batinah Express Highway are less clear-cut than the ground-truthing results. A total of 64 archaeological features were excavated in this stretch — Phases 3 and 4 — of the planned road system, including 51 tombs and 13 suspected domestic structures (Saunders 2016). Encouragingly, every tomb that was dated to the Hafit period by the excavators was also identified as such on Google Earth, these accounted for 15 of the 28 tombs. However, the other 13 tombs were also identified as Hafit during the B-GE survey, but after excavation they were tentatively identified as a small Honeycomb Tomb and 12 possible Cell Graves, 11 of which within the same necropolis stretching across two neighbouring hills (Saunders 2016: 17–20, 32–54). Including these excavated tombs reduces the overall success rate in distinguishing Hafit tombs from other types to 74/88 (84.1%). However, this represents a small sample from a very restricted and in some ways atypical area of the Batinah where the condition of the tombs was generally poor — indeed, many were too disturbed to be able to classify before excavation. Moreover, the tombs tentatively identified as Cell Graves during the excavations are not typical of that type across the rest of the Batinah (Chapter 5) — they are larger, are closer to circular than oval, have rounder chambers and employ larger rocks in the packing between walls than the small stone and gravel mix that is much more typical. It is therefore possible that some or all are not Cell Graves, but are in fact very simple, and therefore possibly early, Hafit tombs (Figure 4.12) — indeed, they show some resemblance to examples excavated at Jabal Buhais, Kalba, Ra's al-Hadd and Tawi Silaim (Jasim 2012: 127; Eddisford and Phillips 2009: 111; Salvatori 2001; de Cardi, Bell, et al. 1979: 68–70), and to descriptions of the small, early Hafit tombs excavated in Dhank (Williams and Gregoricka 2013). If these structures do turn out to be early Hafit tombs, then the reliability of the method remains above 95%, if not then it drops to below 85%, but I believe that even then this is not a true reflection of the reliability of the process due to the poorly preserved and unusual architecture of these particular tombs. The excavation or publication of more Hafit and LPTs from the Batinah would assist in clarifying the issue, but nonetheless the B-GE survey results have proved to be generally reliable.

At a low level of magnification it is not possible to distinguish Hafit tombs from LPTs in Google Earth accurately, but at higher levels of magnification reliability is greatly improved although still imperfect, as a minority of tombs are impossible to classify even on the ground. Other than the 1km B-GE survey — a preliminary dataset used only to identify tomb rich areas — a high level of magnification is used in every Google Earth survey in this thesis (Table 4.1, Figure 4.13). Groundtruthing results

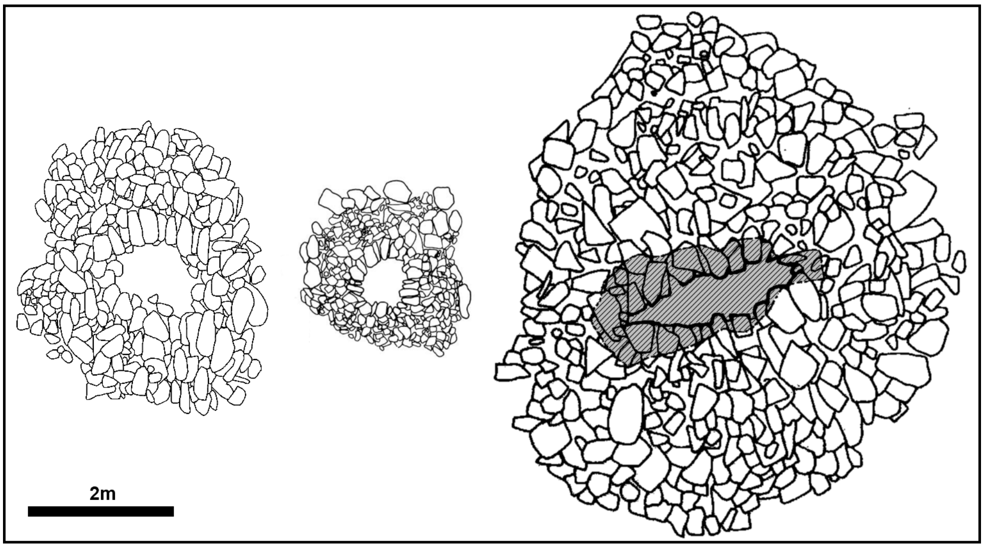


Figure 4.12: Comparison between a typical Batinah Express Highway tomb (left) and two very simple Hafit tombs excavated elsewhere in the Oman Peninsula (Saunders 2016: fig. 97; Eddisford and Phillips 2009: fig. 3; de Cardi, Bell, et al. 1979: fig. 5)

suggest that while the 1km B-GE survey cannot reliably distinguish Hafit tombs from LPTs (Chapter 5.2.1, 5.3.1), the 12 arcsecond method used in the final phase of the BGE survey and elsewhere in the thesis is much more reliable (Chapters 3.3, 4.4.1 & 5.3.1). This chapter describes the northern Oman Peninsula Google Earth (NOP-GE) survey. The relative density and ubiquity of Hafit tombs across the region is mapped as a grid of 10km squares — a timed sampling survey methodology is used in which five minutes is spent assessing the distribution of Hafit tombs in every individual square, and an ordinal score is awarded to each (Chapter 4.3.1). No ground-truthing was carried out for the NOP-GE survey, but as the suspected tombs are examined to a greater level of magnification than that used during the 12 arcsecond surveys, the data should be as or more reliable (Table 4.1, Figure 4.13).

Table 4.1: The magnification level and reliability of distinguishing Hafit tombs from others for each Google Earth survey

	window width (m)	screen width (cm)	magnification (m/cm)	reliable
12" Ja'alan (C3.3)	~370	33	11.2	✓
NOP-GE (C4.3.1)	~270 (max)	33	8.2	✓
12" NOP-GE (C4.4.1)	~370	33	11.2	✓
1km B-GE (C5.2.1, 5.3.1)	1000	40	25	X
12" B-GE (C5.3.1)	~370	40	9.3	✓

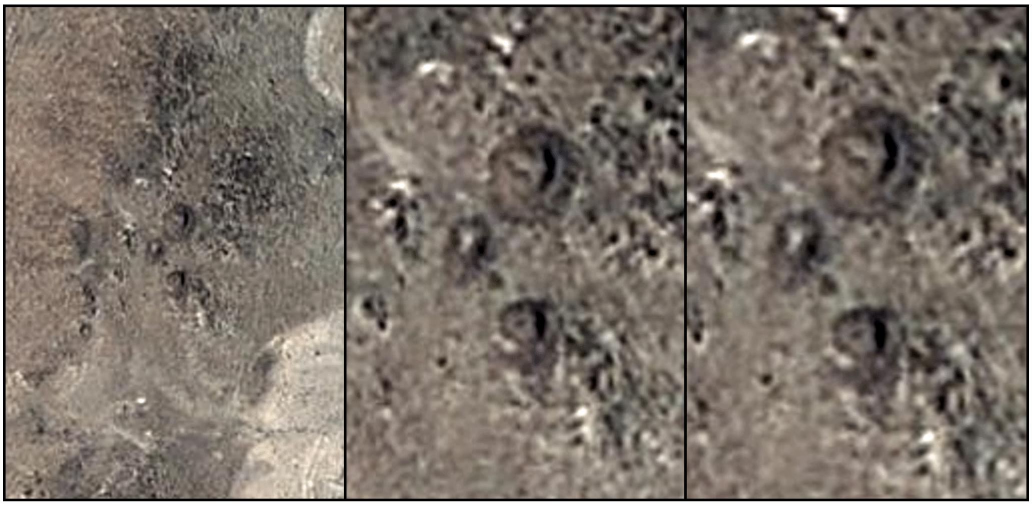


Figure 4.13: Actual magnification level used in the three different Google Earth surveys showing the same group of Hafit tombs

4.2.4 Overall reliability

The present author is confident that as long as the surveyor 1) has a good understanding of the region's funerary archaeology, and 2) utilises a sufficiently high level of magnification, it is possible to distinguish Hafit tombs from Later Prehistoric Tombs in Google Earth almost as accurately as on the ground. It would be naive to claim that such survey is perfectly accurate and to guarantee the correct identification of every tomb — the ground-truthing results and the Batinah Express Highway excavations demonstrate that poorly preserved tombs are difficult to identify with any certainty on the ground, let alone remotely — but there is good evidence that overall in the thesis the vast majority of Hafit tombs have been accurately identified and the number of errors is sufficiently small so as to not bias data analysis. Extensive ground-truthing carried out in the Batinah places reliability rates in the region of 84 and 98%. The distinct spatial and environmental distribution patterns of the Batinah's Hafit and LPTs apparent from the GIS analysis further supports this (Chapter 5.4.3). However, it is also clear that the process of distinguishing tomb types from satellite imagery is not totally reliable, just as few archaeological classifications based on ground-based observations ever can be. It is therefore clear that conclusions about Hafit society, population and activity based on such data must must be tempered and expressed with due caution. Moreover, if, in the future, more excavation of large numbers of Batinah tombs is carried out yielding firm dating evidence, then it may be possible that the question of reliability will need to be revisited. In the meantime, rather than waiting for such progress to be made with dating and typology, it is hoped that by attempting such broad, large-scale analyses, further insight will be obtained along with a better understanding of the distribution and variability of tombs in the Batinah and the wider region.

4.3 Google Earth survey

4.3.1 Method

Covering such a large area, the northern Oman Peninsula Google Earth (NOP-GE) survey did not attempt to map the location of every Hafit tomb. Rather, the study area was divided into grid squares to be individually sampled, summarising Hafit tomb distribution in each. After trialling different sizes a 10km grid was selected as the best compromise between data resolution, and the time it would take to complete the survey (Figure 4.14). To ensure a fair test and consistency throughout, a five minute time limit was set on the survey of each of the 873 grid squares. The number and ubiquity of the Hafit tombs was assessed in each grid square and a qualitative score was awarded to each. This method was developed to ensure that as much of each grid square was explored as possible.

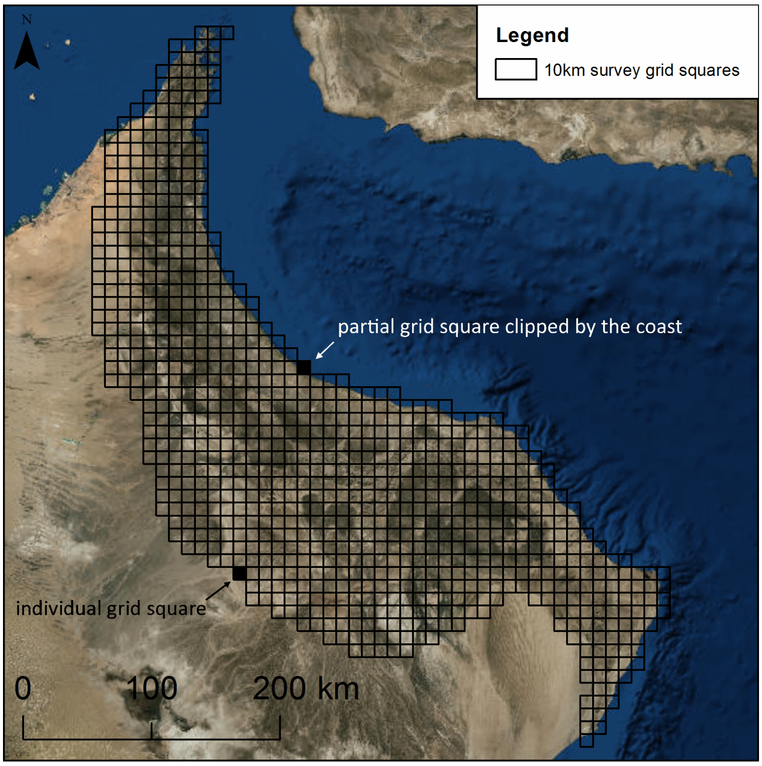


Figure 4.14: The study area and the array of 10km survey grid squares to be surveyed

The 10km NOP-GE grid was created in **ArcGIS** and exported to Google Earth for the survey[2]; smaller 5km and 2.5km grids subdivide the grid squares to help guide survey (Figure 4.15). A stopwatch was used to ensure that exactly 5 minutes was spent surveying each square, ~20 seconds for each of the smaller 2.5x2.5km squares. If clipped by the coastline, the survey time was reduced in proportion to the grid square's area. Every one of the 873 grid squares was surveyed.

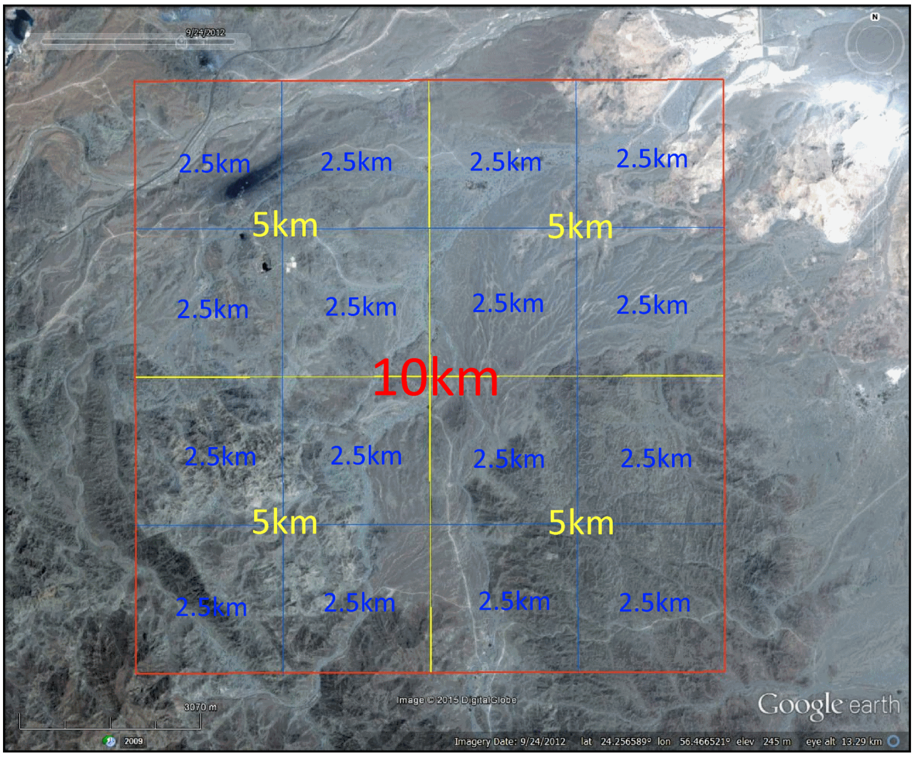


Figure 4.15: Annotated example of the NOP-GE grid square guidelines: the red grid square is surveyed in 5 minutes with ~20 seconds spent on each blue sub-square, the yellow squares make it easier to keep track of progress through the survey

Before surveying each grid square the Google Earth **Historical Imagery Tool** was used to select the most appropriate satellite imagery — the clearest and highest resolution imagery that covered the entirety of the grid square. In five minutes it is possible to briefly examine 45–50 separate locations — each approximately 800x500m in area — at an initial magnification of ~24.2 m/cm using a 33cm-wide computer screen, increasing to ~8.2m/cm to examine any suspected Hafit tombs (Figure 4.16). At this more detailed level, an average Hafit tomb is approximately three quarters of a centimetre in diameter on the imagery. Although not every part of each grid square was examined and the location

[2]the **Create Fishnet Tool** was used with the spatial extent of the study area, then this **feature class** was **clipped** to the shape of the land area of the northern Oman Peninsula based on **dissolved** 1:250,000 U.S. State Department **polygons** of the eastern Arabian countries, and finally the appropriate grid squares were selected using the **Select Layer By Location Tool** and exported as a new **feature class** before this file was exported to Google Earth with the **Layer to KML Tool**

of Hafit tombs was not mapped, the tombs that are observed may be examined at a high level of magnification allowing any Later Prehistoric Tombs to be discounted (Chapter 4.2).

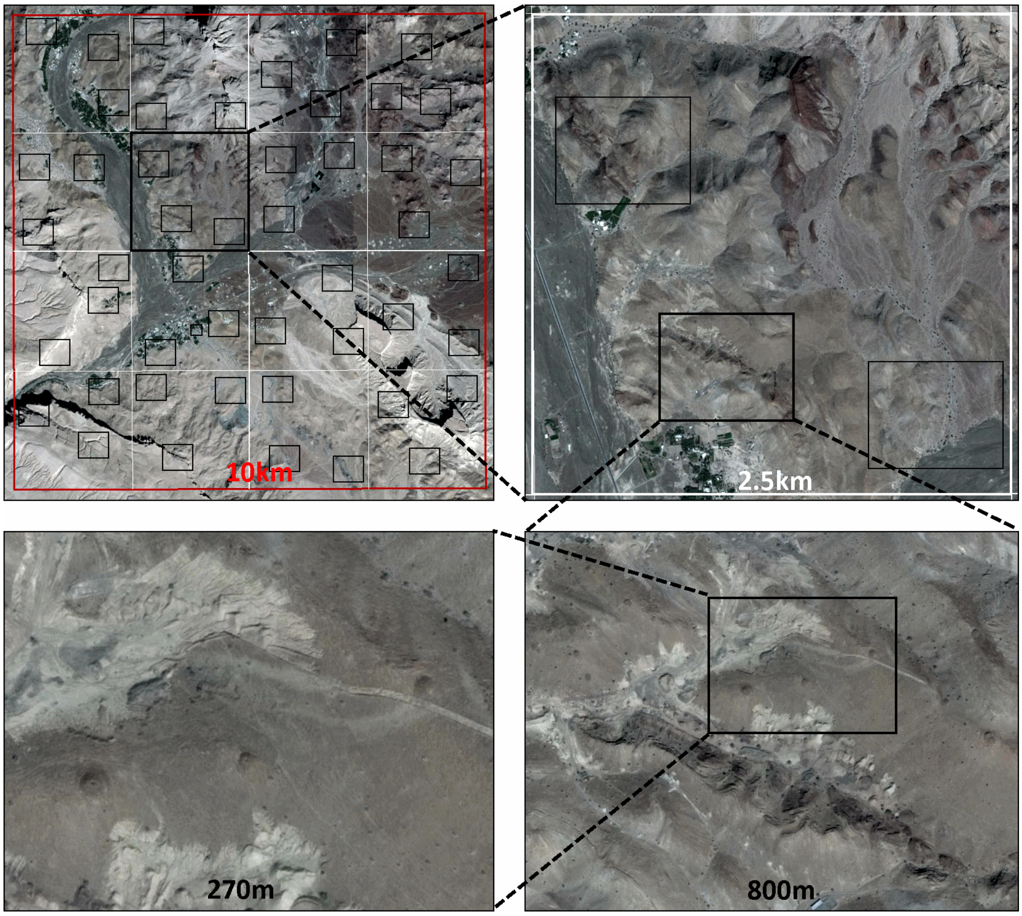


Figure 4.16: Simulated coverage and levels of magnification of the five minute survey of one NOP-GE grid square

Squares in which Hafit tombs were absent were awarded a '0' score; those with low density and ubiquity (a small number of tombs in a small number of locations) were awarded a '1'; squares with either low density but high ubiquity, or high density but low ubiquity (a small number of tombs scattered across a large number of locations, or a large number of tombs found within a small number of locations) were assigned a '2'; squares with a high density and ubiquity (a large number of tombs across a large number of locations) were given a '3'; and finally squares in which only low-resolution satellite imagery was available for more than a quarter of the area were awarded a 'U'. For example: during the survey of a typical '3' square three or more Hafit cemeteries with at least 20 or 30 tombs in each would be observed, or a single massive cemetery of hundreds of Hafit tombs covering a very large area; during the survey of a typical '2' square either three or more small clusters of fewer than twenty Hafit tombs would be observed, or one or two small cemeteries of 20 or 30 tombs; and during the survey of a typical ‘1’ square one or two small clusters of between 1 and 10 tombs would be observed.

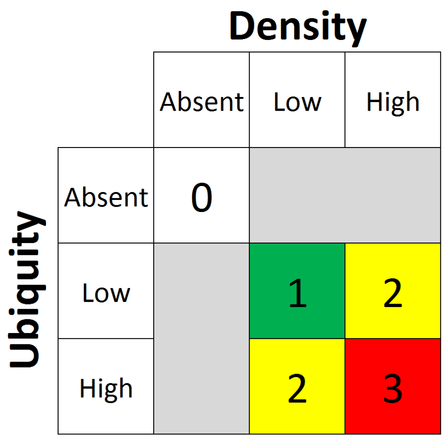


Figure 4.17: Ordinal scoring system for Hafit tomb distribution in the 10km grid squares, based on the density and ubiquity of the structures

Upon completion of the NOP-GE survey each of the 873 grid squares — ~81,000 sq-km of the northern Oman Peninsula — had an individual qualitative score summarising the number and ubiquity of Hafit tombs within it.

4.3.2 Results

The NOP-GE survey took approximately 100 hours, spread over the course of several weeks. The number of the 873 grid squares scored at each level varies considerably (Table 4.2, Figure 4.18). ‘0’ squares, in which no Hafit tombs were observed, make up almost two thirds of the total. A small number of Hafit tombs across a small number of locations were noted in almost 20% of the grid squares, which were awarded a score of ‘1’. Slightly fewer grid squares boasted either few Hafit tombs over a large number of sites or a large number of Hafit tombs over a few sites and were assigned a score of ‘2’. A large number of tombs across a significant number of sites were observed across only a very small number of squares, which were awarded a score of ‘3’. Relatively few squares — less than 2% — could not be surveyed due to a lack of suitable satellite imagery.

The NOP-GE survey results show a clear pattern — the grid squares are not randomly distributed across the study area, but are clustered, favouring certain areas (Figures 4.19, 4.20). A disproportionate number of ‘3’ squares — nine of the eleven — are located on the southwestern side of the Hajar Mountains, and all are surrounded by ‘2’ and ‘1’ squares. Frequently, areas devoid of tombs immediately surround these groups of grid squares. Only a tiny proportion of tomb-containing squares are found in complete isolation —

Table 4.2: Frequency and percentage of ordinal scores of survey squares

Score	Frequency	Percent (%)
0	541	62.0
1	170	19.5
2	137	15.7
3	11	1.3
U	14	1.6
Total	873	100.0

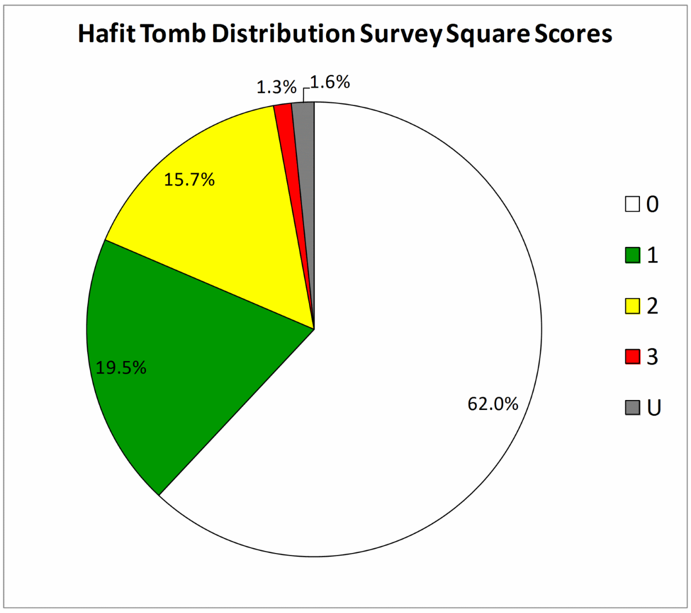


Figure 4.18: Percentage frequency of ordinal scores of Hafit tomb distribution in grid squares

surrounded by '0' squares on all sides; all of these are '1' squares. Major areas of Hafit tomb absence, or very low density, run through the centre of the study area and across the southern and western periphery. Relatively few tombs were observed in grid squares at or adjacent to the coast; the vast majority that are are located in the easternmost region of the study area.

4.3.3 Analysis & discussion

The NOP-GE survey results will be analysed in greater detail later in the chapter, but a number of preliminary observations are immediately apparent. The method was successful — a huge area of 81,137 sq-km was surveyed, taking a single person only 100 hours, and generating the clearest and most detailed picture of Hafit tomb distribution in the northern Oman Peninsula yet to be produced. Fewer than 2% of grid squares could not be surveyed due to a lack of suitable high-resolution satellite imagery.

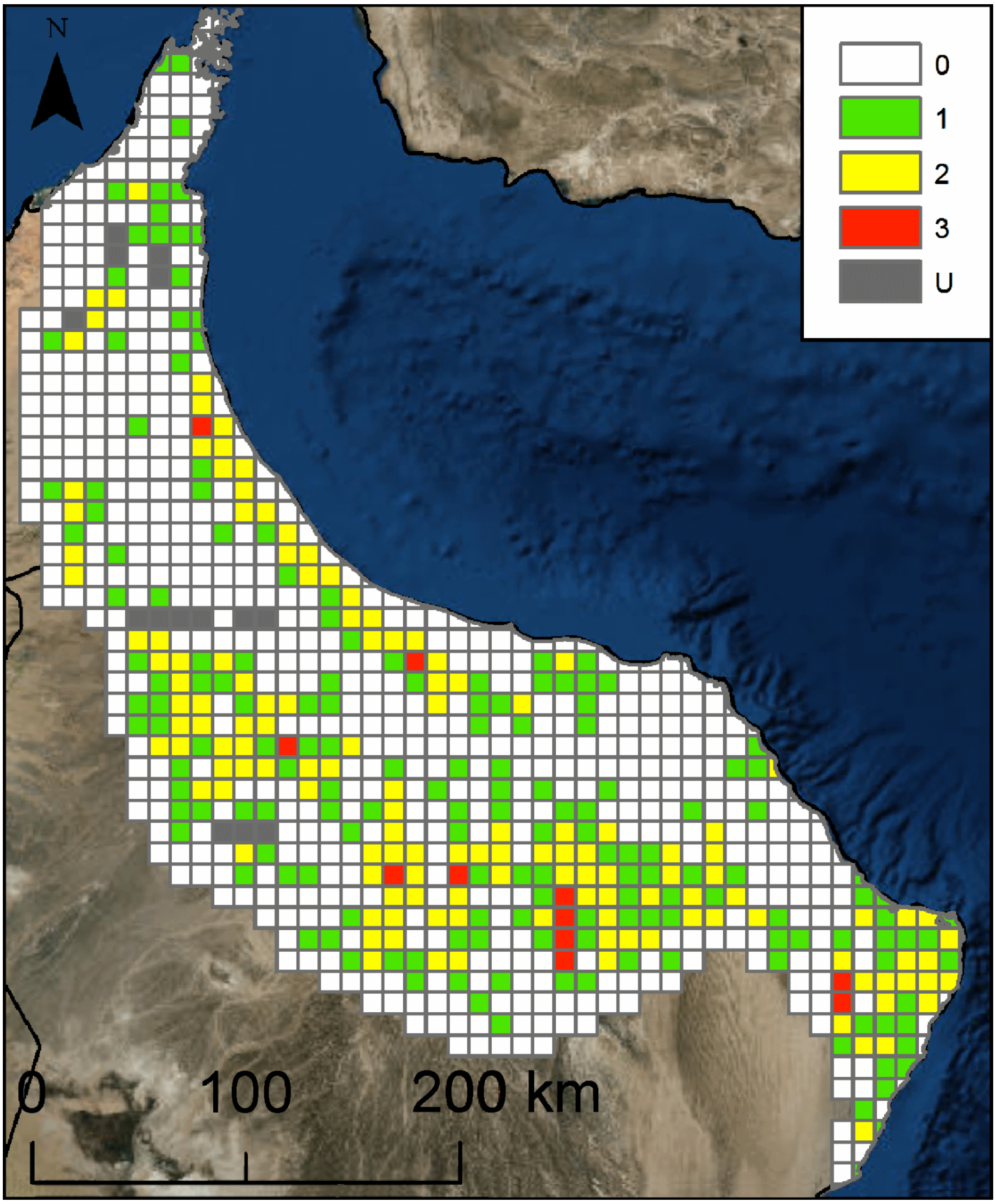


Figure 4.19: Northern Oman Peninsula Google Earth survey results

The results clearly shows distinct areas boasting significant numbers of Hafit tombs, and other areas of void. To some extent the distribution of these areas corresponds to the geography of the northern Oman Peninsula. Hafit tombs are absent from the uplands of the Hajar Mountains and Musandam, from the plains in the south and east and in the Batinah, and from the desert fringe of the Wahiba Sands and the Rub' al-Khali. Hafit tombs congregate in the foothills on both sides of the Hajar Mountains. There are very few near the coast: of the 123 coastal grid squares only 26 (21%) boast Hafit tombs: 8 '2', 18 '1' and 97 '0' squares. The vast majority are in eastern Sharqiyah: 17 of the 26,

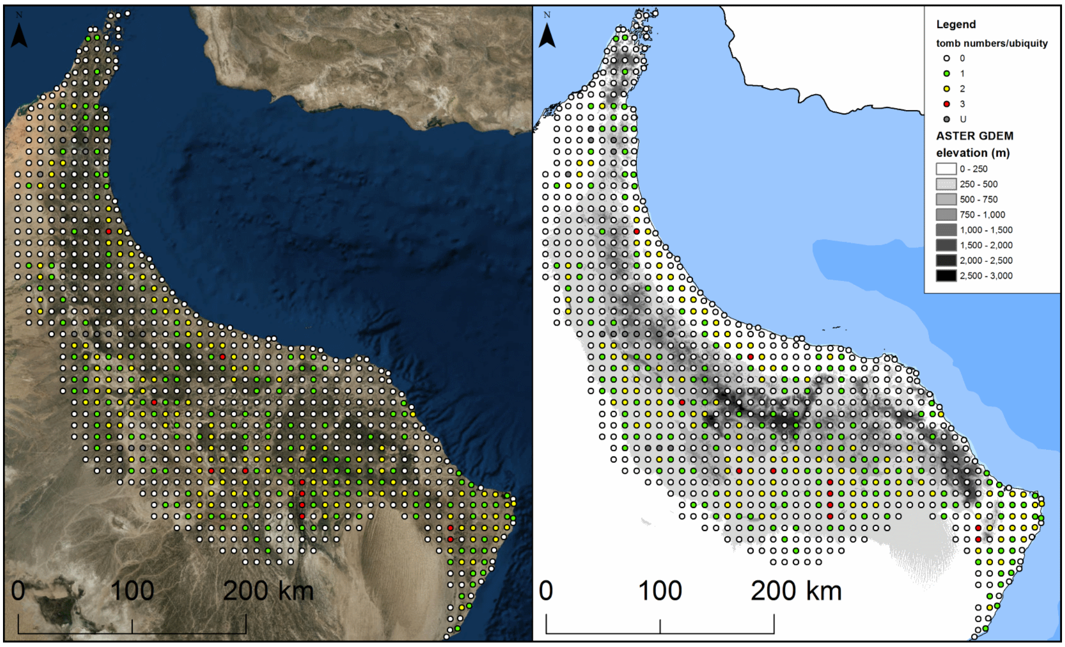


Figure 4.20: NOP-GE survey results with satellite imagery and a digital elevation model

including 7 of the 8 ‘2’ squares. This is the only part of the northern Oman Peninsula where the coast meets a large area of foothills rather than uplands as in Muscat, northern Sharqiyah and Musandam, or plains as in the Batinah and much of Ras al Khaimah where very few Hafit tombs were observed. However, there is an interesting tomb void in the eastern Emirates and parts of Musandam and Ras al Khaimah which do not follow this simple topographical model.

Grid squares with Hafit tombs cluster together, surrounded by either areas absent of tombs or bordering groups. This is confirmed by an analysis of grid squares neighbours: ‘0’ squares have a greater number of ‘0’ square neighbours and fewer ‘1’, ‘2’ and ‘3’ square neighbours than the average; conversely the grid squares containing Hafit tombs have a diminishing number of ‘0’ neighbours and a greater number of ‘1’, ‘2’ and ‘3’ neighbours as tomb numbers/ubiquity increases (Figure 4.21). Not only do grid squares with Hafit tombs agglomerate, but these clusters tend to have more tombs at the centre than the fringes.

Topographically, these clusters tend to overlap with wadi basins — especially on the southwestern side of the Hajar Mountains — with tombs running along the course of the major channels in high numbers, surrounded by a lower density of structures in the basin periphery (Figure 4.22). These interior, wadi basin agglomerations tend to be centred in the foothills and share borders with other clusters to the east and west; to the north and south the tomb distribution peters out in the uplands and plains respectively. The large number of ‘3’, ‘2’, and ‘1’ grid squares in these basins demonstrates a strong Hafit preference for wadi channels and the Hajar foothills. The Batinah Hafit tomb distribution

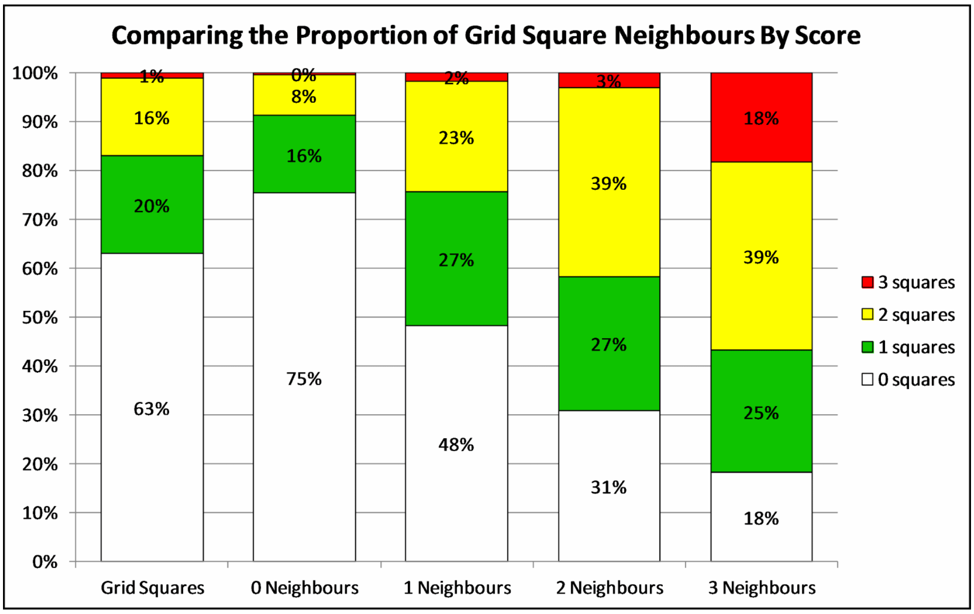


Figure 4.21: The proportion of grid squares and grid square neighbours by grid square score

does not follow this pattern — the grid squares form a single band running parallel to the coast and the mountains. Rather than running alongside the channels of the middle stretch of the wadi courses, this ‘Batinah band’ runs ‘horizontally’ across the lower foothills; spatial correlation with drainage basins is very much weaker in this region.

The NOP-GE survey results and the distribution of known Hafit tomb sites show some clear similarities but also considerable differences (Figure 4.23). Cemeteries within most of the ‘3’ squares have already been discovered and appear in the literature. Surveys in Ja’alan have recorded sites within the two neighbouring, easternmost ‘3’ squares (Doe 1977; Edens 1987; 1990; al-Jahwari 2013a). Similarly, the Hafit tombs of Wadi ‘Andam — the largest group of four ‘3’ squares — have been surveyed in great detail (al-Jahwari 2008; 2013b; Deadman 2012a; 2014). A great deal of research has also been carried out into the Hafit tombs located in the Bat and Bisya areas to the west (Frifelt 1975a; de Cardi, Collier, et al. 1976; Gentelle and Frifelt 1989; Böhme 2011; Orchard 2000; Degli Eposti and Phillips 2012), within the two single ‘3’ squares. However, between Wadi ‘Andam and these two known Hafit tomb concentrations lies another single ‘3’ square that contains no published cemeteries. The grid square encompasses the village of Izz, as well as hundreds of Hafit tombs on the hills and ridges south and east of Wadi Khawan — the area undoubtedly merits further archaeological investigation, being one of the densest concentrations of Hafit tombs in the northern Oman Peninsula. The other two ‘3’ squares form particularly dense tomb hotspots in the Hafit ‘Batinah band’ and so far are both unreported. The southern ‘3’ square lies at the northernmost extent of the *wilaya* of Rustaq where it meets the border of Suwaiq and Musannah; many hundreds of Hafit

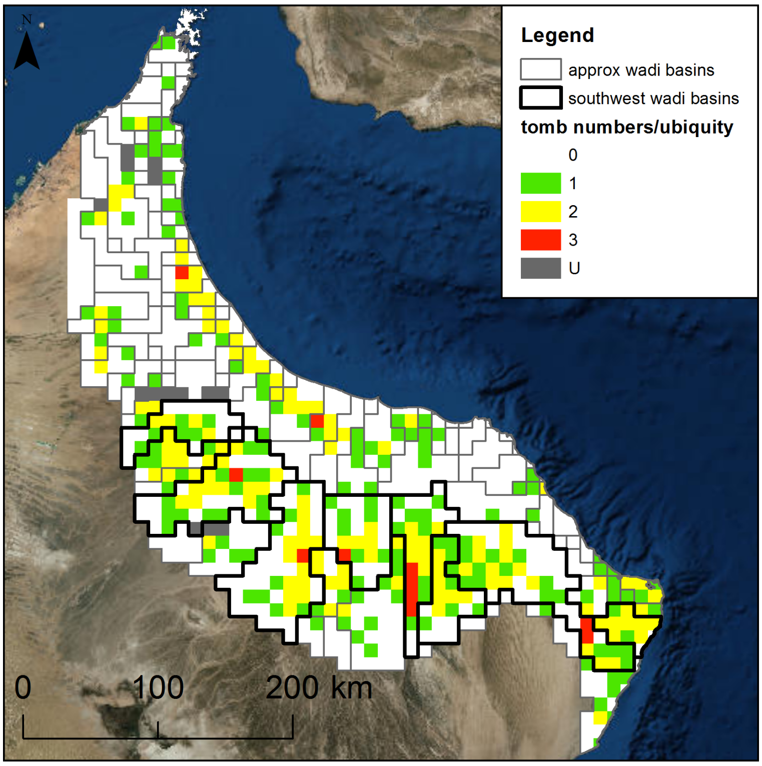


Figure 4.22: The overlap between Hafit tomb grid square agglomerations and wadi drainage basins, especially on the southwestern side of the Hajar Mountains

tombs cover the low bajada hills in this grid square. The other Batinah '3' grid square lies in the far north, southwest of Shinas, centring on Wadi Rajmi, and boasts hundreds of Hafit tombs located on hills and ridges overlooking the wadi. As would be expected with lower numbers and ubiquity of Hafit tombs, fewer '2' squares contain known cemeteries than '3' squares — just over a quarter. This varies considerably by region according to the intensity of survey and archaeological research: in Ja'alan and Wadi 'Andam the majority of '2' squares contain a known site as there has been a great deal of survey in these areas (Edens 1987; Giraud and Cleuziou 2009; al-Jahwari 2008; Deadman 2012a); the proportion is much lower in other inland wadi basins, but the majority of yellow clusters share at least one known site; the Batinah boasts the lowest proportion — only two Hafit sites are known from 27 '2' grid squares. A very similar pattern is apparent in '1' squares although, as would be expected, the number of known Hafit site within the grid squares are fewer — just over 1 in 8, with no '1' square containing more than two known sites.

Conversely, a number of '0' squares — absent of tombs according to the NOP-GE survey — contain known Hafit cemeteries. Fourteen known Hafit sites are situated within thirteen '0' squares. Only ~2.5% of '0' squares encompass a Hafit cemetery, and just over 1 in 10 known Hafit tomb sites are located in a '0' square. There is significant variation between the sites (Table 4.3). The NOP-GE survey cannot hope to locate every Hafit tomb in a 100 sq-km grid square in five minutes, so it is unsurprising that some

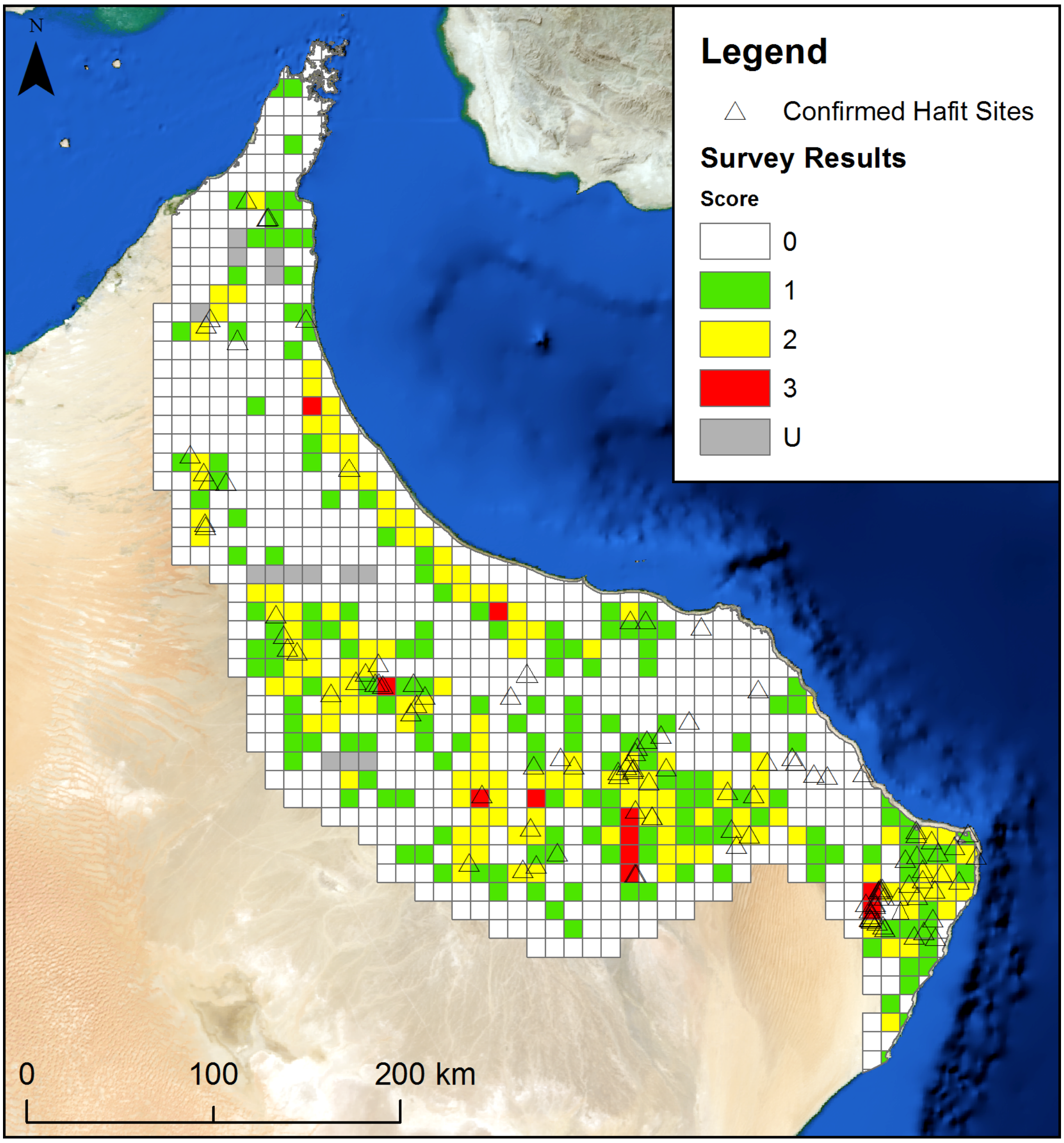


Figure 4.23: NOP-GE survey results and known Hafit tomb sites from the literature

sites were missed. The majority are made up of a small number of Hafit tombs (Wadi al-Qawr, Zammah, Siyudian, Ba'id, Ism'iyah), often spread over multiple locations (Shariq, Maqta'ah), frequently in poor condition (Qarn Kabsh, Izki, Saih Buerid, Shariq), and sometimes in areas that have been rapidly urbanised since their discovery (Bausher). However, three of the sites boast a significant number of tombs, and therefore the failure to detect them requires further explanation. The 58 famous 'tower tombs' at Shir are clearly visible on Google Earth's satellite imagery, but they are spread thinly, in small clusters over an area of 15–20 sq-km (Yule and Weisgerber 1998: figure 1) — missing this site may credibly be attributed to bad luck. Similarly, the 98 Hafit tombs[3] at Wadi Bani Awf are stretched across the whole ~15km length of the survey area; the

[3] there is inconsistency within the published survey results — one article reports 98 Hafit tombs (Häser 2000: 117), and another "about sixty" (Häser 2003: 21)

majority were in poor condition, and they were clustered in small groups of between two and ten (Häser 2000: 117). Tiwi is a very different site — 130 Hafit tombs are densely distributed within ~1 sq-km of coastal hills between Wadi Shab and Wadi Tiwi (Korn et al. 2002: figure 3). However, many of these tombs were found in terrible condition between modern houses (Schreiber and Häser 2004: 321), and since the survey further urbanisation has taken place as well as the construction of a double-carriage motorway through the path of many of the other tombs; only a tiny number of the tombs located higher up on the hills and ridges are now visible on satellite imagery. Given the size of the survey area as a whole, very few known Hafit cemeteries were missed and the majority are small, isolated sites, often with tombs in a poor condition.

Table 4.3: Known Hafit cemeteries inside '0' grid squares, listed from west to east

Site (code)	Description
Wadi al-Qawr (15)	"beehive tombs", (a small number?) (Phillips 1997: 207; Doe and de Cardi 1983: 31)
Qarn Kabsh (55)	"six beehive tombs... robbed and in poor state" (de Cardi, Collier, et al. 1976: 171)
Zammah	"three or four Hafit/beehive tombs" (Häser 2000: 117)
Wadi Bani 'Awf	"98 Hafit/beehive tombs... in small groups of two to two... most destroyed and/or robbed" (Häser 2000: 117)
Izki	"several Hafit tombs... most... totally destroyed" (Schreiber 2004a: 8–9)
Siyudian	"eight cairns on top of black rocky hills" (al-Jahwari 2013b: 198)
Ba'id (22)	"a group of six circular tombs" (Doe 1977: 45)
Bausher	approximately 15 Hafit tombs (al-Jahwari and ElMahi 2007: map 1)
Saih Buerid (8)	the foundations of a "beehive type tomb" (de Cardi, Collier, et al. 1976: 154)
Isma'iyah	"some Hafit tombs" (Yule and Weisgerber 1998: 209)
Shariq	a small number of Hafit tombs in four clusters, some in poor condition (Yule and Weisgerber 1998: 210–211)
Maqta'ah	three Hafit tombs in three clusters (Yule and Weisgerber 1998: 209–210)
Shir	58 Hafit/"tower tombs" (Yule and Weisgerber 1998)
Tiwi	130 Hafit tombs, mostly between houses and in poor condition (Schreiber and Häser 2004: 321)

More generally, the NOP-GE survey results match the distribution of known Hafit tomb sites in eastern Sharqiyah where extensive survey has been carried out. There is also some correspondence between the datasets in the interior, on the southwestern side of the Hajar Mountains. The lack of correlation in the Batinah, the northern Emirates and Musandam reflect the lack of archaeological research into Hafit tombs in these areas. Overall, the survey methodology is weak when it comes to mapping small, isolated clusters of Hafit tombs, especially if they are in poor condition. However, it is able to map the distribution of high and medium tomb densities with good accuracy, and has generated what is certainly the most reliable map of Hafit tomb distribution yet produced. This has been achieved in a relatively short period — it would take many times longer to replicate through field-based survey.

Although the NOP-GE survey results may reveal a great deal about the Hafit population, due caution should be expressed in the conclusions that are drawn from it. The data has not been ground-truthed, and although a high level of magnification was used in the survey, maximising the chances of accurately distinguishing Hafit tombs from Later Prehistoric Tombs, it would be naive to expect that no mistakes were made in this process, or that they will not to some extent effect the data analysis (Chapter 4.2). Despite this the NOP-GE data nevertheless represents the most accurate map of the relative density of Hafit tombs across the northern Oman Peninsula and forms an invaluable dataset for shedding light on the period.

Having mapped the relative density/ubiquity of Hafit tombs across the northern Oman Peninsula, additional research will now be carried out to utilise these results to estimate the total number of Hafit tombs in the study area and the size of the contemporary human population that inhabited it.

4.4 Quantifying the survey results and estimating the tomb and human population in the northern Oman Peninsula

The objective for this section is to quantify the NOP-GE survey data to estimate the total number of Hafit tombs that survive in the study area, and the size of the Hafit population. A sample of the grid squares was systematically surveyed in Google Earth, locating every visible Hafit tomb. This data was extrapolated to produce an estimate of the total number of tombs in the study area. In turn, this was used to estimate the size of the living Hafit population. Quantification of the ordinal NOP-GE survey data will provide a more accurate understanding of the variation in tomb density and ubiquity between and within the four grid square scores (3, 2, 1, and 0). Estimating the total number of Hafit tombs and the possible size of the human population will also provide potential insights into the social, political and economical organisation of Hafit society.

4.4.1 Method

Six 10km NOP-GE squares of each level (0, 1, 2, 3) were randomly selected and imported into Google Earth. These twenty-four squares were systematically surveyed for Hafit tombs using methodology already described (Chapter 3.3): using the 12 arcsecond (~370m) Google Earth grid and moving systematically from north to south across each column in turn, and marking suspected Hafit tombs with **placemarks**. Once completed, the survey data was imported into ArcGIS for analysis, and the number of suspected Hafit tombs in each of the twenty-four squares was counted[4].

[4]the **Spatial Join Tool** was used to join the tomb points to the grid square polygons, generating a 'Count' field in the **attribute table**

To assess tomb ubiquity each of the sample squares were subdivided equally into 100 sub-squares — a ‘percentile grid’. The number of the sub-squares to contain 1 or more Hafit tombs was counted, providing a quantified measure of tomb ubiquity for each grid square, expressed as a percentage. Percentile grids were created for each of the sampled grid squares with ArcGIS[5], the number of sub-squares to contain one or more Hafit tombs was then counted for each individual grid square[6].

The sampled grid square data — including: the original ordinal NOP-GE score (3, 2, 1, 0); the number of tombs per square; and the tomb ubiquity score — was exported to Microsoft Excel for analysis. The mean number and mean ubiquity of Hafit tombs was calculated for each ordinal survey score. An estimate for the total tomb population of the study area was extrapolated by adding the product of the mean number of tombs and the total number of survey squares for each ordinal score. This value was corrected to allow for the ‘U’ squares which could not be surveyed, by increasing the estimate by the proportion of ‘U’ squares to other squares.

This estimate was then used to calculate the size of the living Hafit population. Ubelaker has published a simple formula for this purpose:

$$P = \frac{1000N}{MT}$$

“where P is the size of the population, N is the number of deaths represented by the skeletal remains, M is the crude mortality rate, and T is the number of years that the cemetery was in use” (Ubelaker 1999: 140). To apply this formula to Hafit tombs numerous assumptions have to be made that have inherent inaccuracies.

$$Population = \frac{1000 \times number\ of\ tombs \times mean\ individuals\ per\ tomb}{crude\ mortality\ rate \times length\ of\ period\ in\ years}$$

Every one of the variables has to be estimated — this is described in greater detail in the next section — and more than one was included as a range rather than a single value.

There are a considerable number of inaccuracies involved in this process. Not only because only rough estimates are available for the variables, but also because there is considerable doubt as to the extent to which estimable numbers of the dead are proportional to the size of the original living population — the mortuary dataset is often influenced by factors other than population size (Bradbury and Philip n.d.). Therefore

[5]a 1km grid was created over the original 10km survey grid using the **Create Fishnet Tool**, the **Clip Tool** was then used to clip the grid to the area covered by the twenty-four sampled grid squares, creating a smaller 10x10 grid of 100 sub-squares within each

[6]the **Spatial Join Tool** was used to join the tombs to the sub-squares, those containing 1 or more tombs were exported as a new **feature class**, and these sub-squares were joined to the twenty-four grid squares, counting the total number of sub-squares present within each grid square

realistically, applying Uberlaker's formula to Hafit tombs based on the data available will yield an informed guess rather than a seriously credible population estimate. Nevertheless, even a semi-speculative result should provide some insight into the size and density of the Hafit population.

4.4.2 Results

The twenty-four grid squares — six of each NOP-GE score except 'U' — were randomly selected. By chance this random sample has a varied geographical distribution that should minimise a potential source of bias. The sample includes grid squares from the interior and the coast, on both sides of the Hajar Mountains (Figure 4.24).

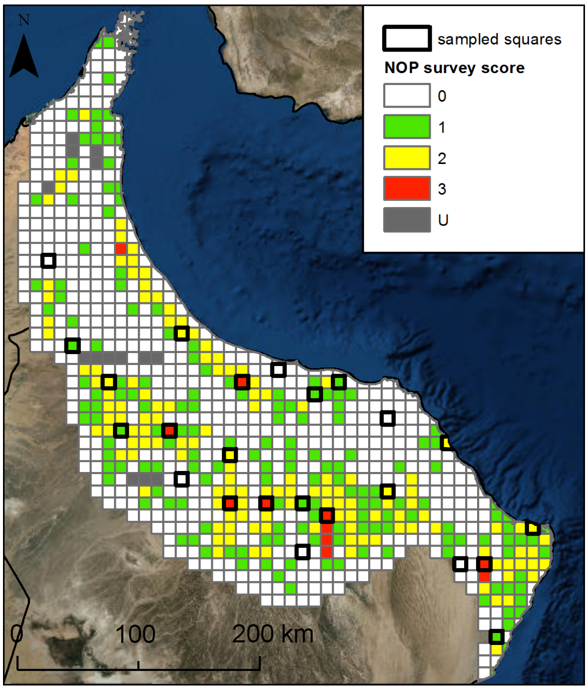


Figure 4.24: Map of the sample of twenty-four grid squares, randomly selected for the quantification survey

Generally, the results follow the expected pattern — the higher a grid square's ordinal score (3, 2, 1, 0), the greater the number and ubiquity of the Hafit tombs (Table 4.4, Figure 4.25). However, there is some overlap in tomb number and ubiquity between the ordinal scores of the sampled grid squares, particularly between '1' and '2' grid squares. This is due to chance that is inherent within the NOP-GE survey methodology — as the distribution of Hafit tombs in each 100 sq-km grid square was assessed for only five minutes, in some cases the true number and ubiquity of Hafit tombs was under or overrepresented. For example, in some '1' squares — boasting a low number of Hafit tombs across a low number of locations — a high proportion of these sites will have been located during the original survey purely by chance, while in other cases a high proportion of sites will have been missed in squares that contain more tombs. Such under or overrepresentation is less likely to happen in survey squares that contain very few or no Hafit tombs or that contain huge numbers of structures over a large area, which is why there is little or no overlap in the number and ubiquity of tombs between '0' and '1' grid squares, or '2' and '3' grid squares.

Table 4.4: Survey quantification raw data for each square, arranged by ordinal score and number of tombs observed

0		1		2		3	
N	U	N	U	N	U	N	U
0	0	5	1	17	6	360	24
0	0	9	2	54	16	582	37
0	0	14	6	62	6	713	69
0	0	27	8	73	13	832	47
3	2	46	13	118	22	1005	45
6	1	62	14	222	27	1259	46

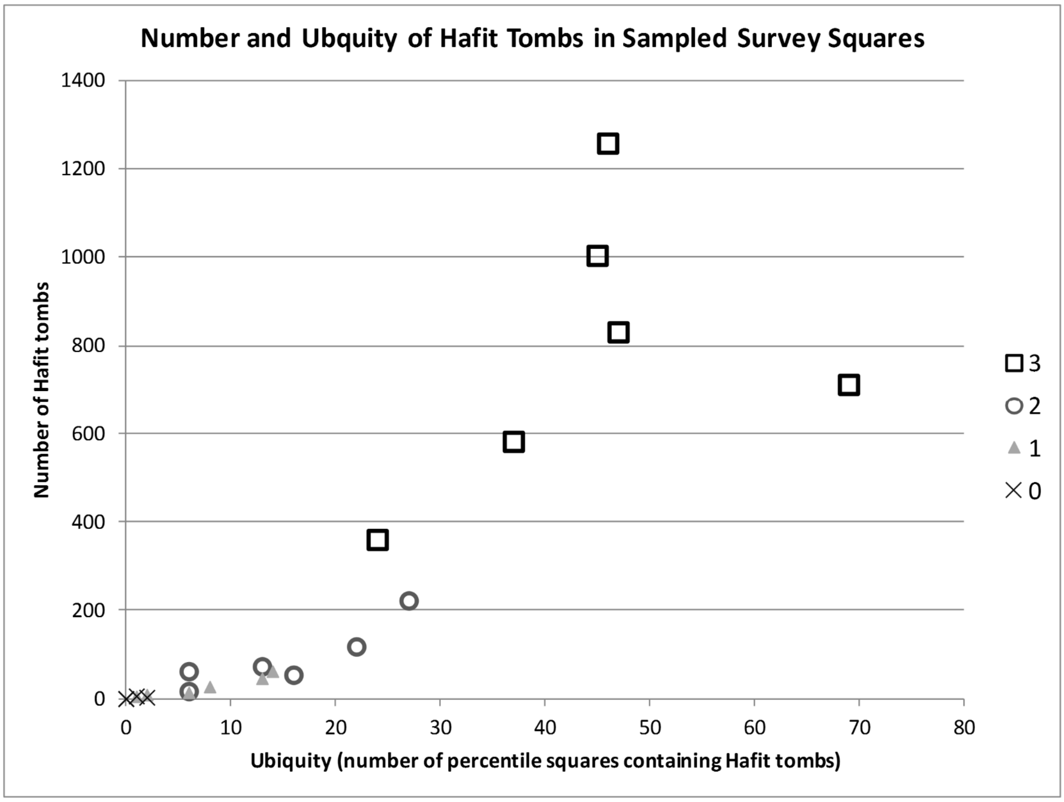


Figure 4.25: Number and ubiquity of Hafit tombs in surveyed sample grid squares

Despite this overlap, statistically there is a clear difference in the number and ubiquity of tombs for each NOP-GE ordinal score (3, 2, 1, 0) — the mean, median, minimum and maximum calculated in each sample are greater than in the lower scores (Table 4.5).

Table 4.5: Statistical analysis of the number and ubiquity of Hafit tombs in sampled grid squares

	Total Tombs				Tomb Ubiquity			
	0	1	2	3	0	1	2	3
Mean	1.5	27.2	91.0	791.8	0.5	7.3	15.0	44.7
Median	0	20.5	67.5	772.5	0	7	14.5	45.5
Standard Deviation	2.5	22.6	72.0	316.9	0.8	5.4	8.5	14.7
Minimum	0	5	17	360	0	1	6	24
Maximum	6	62	222	1259	2	14	27	69

The results of this detailed survey of twenty-four squares were then used to calculate an estimate of the total number of tombs within the entire study area. The mean value of the number of tombs for each scoring level was multiplied by the total number of grids squares with that score; these values were added together, and the total was corrected to allow for the 1.6% of 'U' grid squares (Table 4.6).

Table 4.6: Population estimate of Hafit tombs visible on Google Earth in the study area

Score	μ Tombs	Squares	Product
3	791.8	11	8710.2
2	91.0	137	12,476.0
1	27.2	170	4618.3
0	1.5	541	811.5
total			26,607
corrected total (T/0.984)			27,040

The final corrected estimate for the total number of Hafit tombs in the study area came to 27,040 tombs. However, this is based on Google Earth survey — not all of the tombs will be visible on satellite imagery. It was previously calculated that 50.8% of Hafit tombs located during a meticulous ground survey in western Ja'alan were also visible on Google Earth (Chapter 3.4); assuming that this value is representative of the northern Oman Peninsula as a whole, it can be utilised to correct the estimate to include Hafit tombs that were not located on the satellite imagery. This yields an estimate of 53,236 surviving Hafit tombs in the survey area (Figure 4.26).

To calculate an estimate of the size of the Hafit population in the study area, each of the variables in Ubelaker's formula (1999: 140) need to be estimated. The current Hafit tomb estimate only includes the structures that survive to the present day; reports

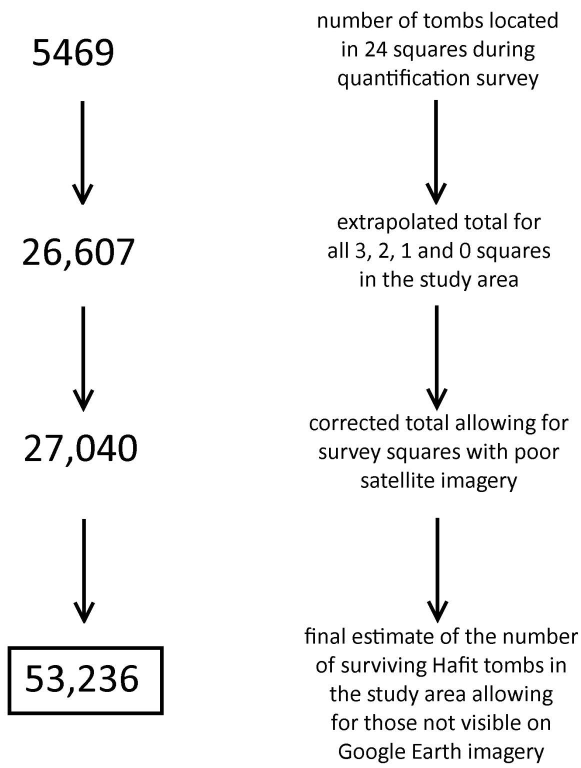


Figure 4.26: The process of estimating the total number of surviving Hafit tombs in the survey area

from the 1950s and 1960s suggest that — in some areas at least — the majority of the tombs have been destroyed in recent times (for example comparing Bibby 1970: 293; to Cleuziou, Vogt, and Méry 2011: 8–10). Elsewhere Hafit tombs have escaped such serious destruction, but there is also evidence for their being deliberately deconstructed to provide building material for Later Prehistoric Tombs (Chapter 5.3.3). It is impossible to calculate the percentage that have survived, but a reasonable — if arbitrary — estimate is between 50 and 90% of the original number.

The average number of individuals interred within each tomb may be calculated by taking the mean of the Hafit MNI for every excavated tomb with the original interments still preserved (see Table 1.10). No research has been carried out into Hafit mortality rates, and so a general estimate of prehistoric life-expectancy will be used: 25 years, a crude mortality rate of 40 (e.g. Preston 1995: 245). A lack of secure dating evidence makes it difficult to define the length of the Hafit period; the two most frequently quoted date ranges are 3,200–2,500 B.C. (700 years), and 3,200–2,700 B.C. (500 years) (e.g. Potts 1997: 66–67; Cleuziou 2007b: 217). By inputting these values and ranges into the formula a final estimate of the study area's average living Hafit population was calculated: between 11.3 and 28.6 thousand people (Table 4.7).

Table 4.7: Living Hafit population estimate calculated with Ubelaker's formula

	constant	min	max
number of tombs		59,151	106,472
mean number of individuals in tombs	5.37		
crude mortality rate	40		
length of period in years		500	700
population		**11,344 to 28,588**	

4.4.3 Analysis & discussion

These results will be discussed in greater detail later in the chapter, but a number of preliminary observations can be made here. The NOP-GE quantification results are consistent: although there is an overlap between some consecutive ordinal scores, there is a clear upward trend in the number/ubiquity of Hafit tombs. Hafit tombs are not necessarily entirely absent from '0' grid squares — they may be present in small numbers. The significant overlap in the number and ubiquity of Hafit tombs in '1' and '2' grid squares demonstrates that the distinction between the two ordinal scores should not be overstated — half of the '1' and '2' grid squares fall within the range of the other score. In contrast, there is a great difference between '2' and '3' grid squares — the '3' grid square with the lowest number of Hafit tombs boasts more than half again as many as the most dense '2' grid square, and on average more than eight times as many tombs were found in '3' grid squares compared to '2' grid squares.

This variation in tomb density and ubiquity demonstrates a clear and strong preference in the Hafit population for certain areas of the northern Oman Peninsula which requires explanation, as does their absence or much lower numbers in the surrounding areas. Just as this chapter presents a uniquely detailed map of Hafit tomb distribution, the estimate of the number of tombs is the first informed attempt to calculate such a figure. The final corrected value of 53,236 tombs is significantly lower than the sole previous guess hazarded — Cleuziou and Tosi suggested that 100,000 could be a low estimate for the total number of Hafit tombs (2007: 122). The Hafit population size calculated for the study area, between 11 and 29 thousand, is small given its size. This is perhaps unsurprising as the estimate assumes that every member of the Hafit population received a burial in a Hafit tomb, something that is demonstrably not the case in many parts of the ancient Near East (Bradbury, Davies, et al. 2016: 566; Bradbury and Philip n.d.). Over an area of 81,137 sq-km, the average population density works out to between 0.14 and 0.35 people/sq-km. If 0 squares are excluded — many of which are situated in the higher uplands of the Hajar Mountain range and the southern desert — limiting the area to 30,930 sq-km, the population density rises to between 0.35 and 0.92 people/sq-km.

4.5 GIS analysis of the survey results

GIS analysis of the NOP-GE survey results has the potential to shed light on the Hafit economy and socio-political organisation. It is clear that certain parts of the study area were more favoured by the Hafit population than others — by analysing the environmental and anthropogenic distribution of '3', '2', '1' and '0' grid squares it should be possible to uncover some of the factors that dictated this.

The aim of this section is to analyse the NOP-GE survey data, examining the relationship between Hafit tomb numbers/ubiquity and numerous environmental and anthropogenic variables in order to shed light on Hafit period occupation at a macro-regional scale. This will yield a generalised picture of Hafit tomb distribution and Hafit society which can be compared to the results of the later, more detailed Batinah-based research (Chapters 5, 6 & 7). Elevation and topography variables will be analysed in order to pinpoint where Hafit populations were based within the study area, and where they chose to position their tombs within the landscape. Hydrological factors will be investigated in order to analyse the relationship between the availability of water and the Hafit occupation of the landscape. Recent settlement patterns will be compared to Hafit tomb distribution to investigate Hafit economic strategies. The availability of copper ore and marine resources will also be considered which should provide some insight into their significance in the Hafit economy and society. The relationship between Hafit tomb distribution and that of Umm an-Nar sites will be investigated, examining the development of Hafit society over time, as well as socio-economical differences between the two phases of the Early Bronze Age.

4.5.1 Method

The approach of the GIS analysis is to characterise the natural and anthropogenic environment of every grid square — including elevation and topography, hydrology, modern settlement, natural resources, and Umm an-Nar archaeology. Generating such data for each grid square makes it simple to gauge the relationship between Hafit tomb numbers/ubiquity and environmental variables, and to assess the significance of natural and anthropogenic factors in shaping the Hafit occupation of the landscape. This requires quantitative data for each environmental variable that may be linked to the grid squares. Creating an ArcGIS **raster** — an image-like visual representation of data based on a equally sized-cells arranged in rows and columns — for each individual variable allows data to be statistically summarised for each grid square. In some cases the variable data is already suitable, for example a **digital elevation model** can be used to calculate the average elevation within each grid square (Figure 4.27, above). In other cases rasters must be generated. Thus, a **feature class** — vector-based data in point, line or polygon form — of sizeable wadi channels must first be converted into a raster showing 'distance to nearest wadi' — making it possible to calculate the mean distance to a wadi channel for each grid square (Figure 4.27, below). In this way, one value will be calculated for each variable for each grid square.

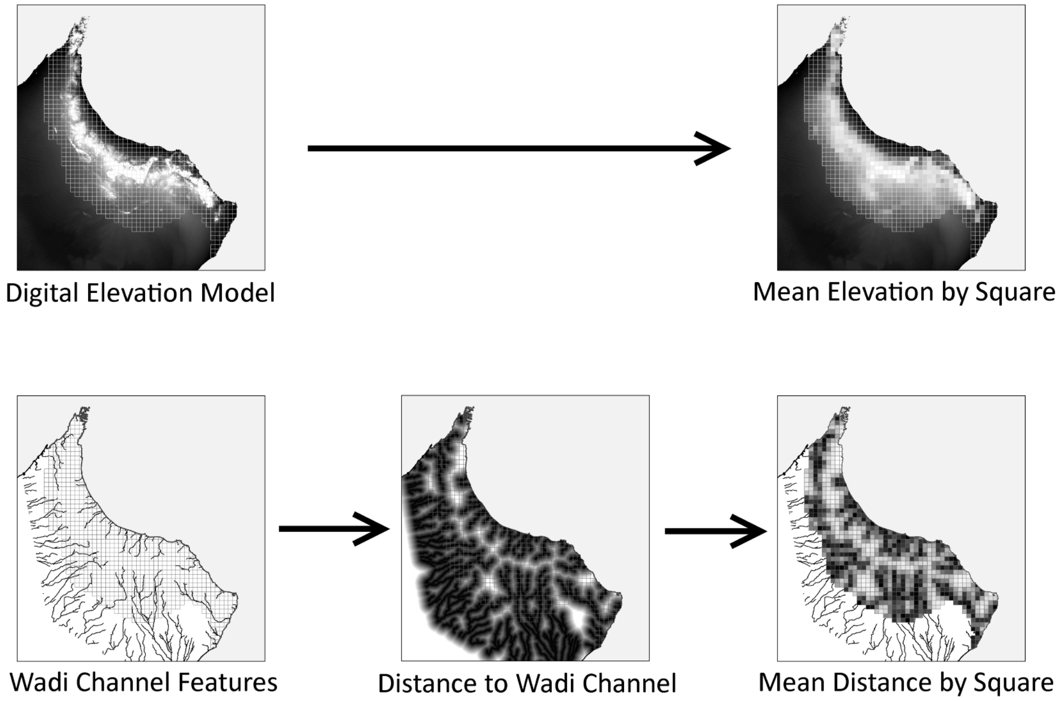


Figure 4.27: Two examples of GIS analysis of environmental variables — mean elevation, and mean distance to wadi

Twelve environmental and anthropogenic variables were analysed (Table 4.8), and five approaches were taken to generate rasters and summarise the data for each grid square for each variable, slightly altering the same basic method:

- for 'mean elevation' the average elevation within each individual grid square was calculated from a **digital elevation model** that covered the whole area[7]; for 'mean slope' the same method was applied to a slope raster generated from the digital elevation model[8]
- for 'max flow accumulation' the maximum flow accumulation within each individual grid square was calculated [9]; for 'maximum slope' the same method was applied to the slope raster

[7]utilising the ArcGIS **Zonal Statistics As Table Tool**, selecting the DEM raster, the grid square polygon file, and the 'mean' option

[8]using the ArcGIS **Slope Tool**

[9]with the **Zonal Statistics As Table Tool**, but selecting the flow accumulation raster, and the 'max' option

- for 'elevation range', the maximum and minimum elevation within each grid square was calculated and the former was subtracted from the latter[10]
- for the six variables involving distance ('mean distance to sizeable wadi', 'mean distance to modern settlement', 'mean distance to copper ore', 'mean distance to coast', 'mean distance to Umm an-Nar site', and 'mean distance to major Umm an-Nar site'), first a raster showing the distance from the resources/sites was created for each variable, and then the mean distance was calculated for each individual grid square[11]
- for 'modern settlement density' a density raster was generated and an average value was calculated for each individual grid square[12]

Table 4.8: The environmental and anthropogenic variables analysed

General Category	Variable	Unit
elevation and topography	mean elevation elevation range mean slope max slope	metres metres degrees degrees
hydrology	max flow accumulation mean distance to sizeable wadi	km^2 or watercourse category kilometres
landuse and modern settlement	mean distance to modern settlement mean density of modern settlement	kilometres settlements/sq-km
natural resources	mean distance to copper ore source mean distance to coast	kilometres kilometres
early bronze age archaeology	mean distance to Umm an-Nar site mean distance to major UaN site	kilometres kilometres

Various datasets from different sources were required to generate a raster for each variable. Each of the elevation and topography variables used the same dataset — the 'ASTER Global Digital Elevation Model', jointly owned by NASA and the Japanese government. This **georeferenced**, 30m resolution raster data is available for free, downloaded from NASA's website as 1 square-degree **GeoTIFF** files. A single raster covering the northern Oman Peninsula was generated by combining the relevant files together in ArcGIS. A slope raster was generated from this dataset, showing the approximate gradient of the ground across the same area (Figure 4.28).

[10]the **Zonal Statistics As Table Tool** was used twice on the the DEM with the 'maximum' and 'mean' options, and the subtraction was carried out in Excel

[11]the **Euclidean Distance Tool** was used to create the distance rasters, using a **feature class** of the resources/sites for each variable, and then the average values were calculated using the **Zonal Statistics As Table Tool**

[12]the **Point Density Tool** was used to create the raster, and the **Zonal Statistics As Table Tool** was used to calculate the individual values

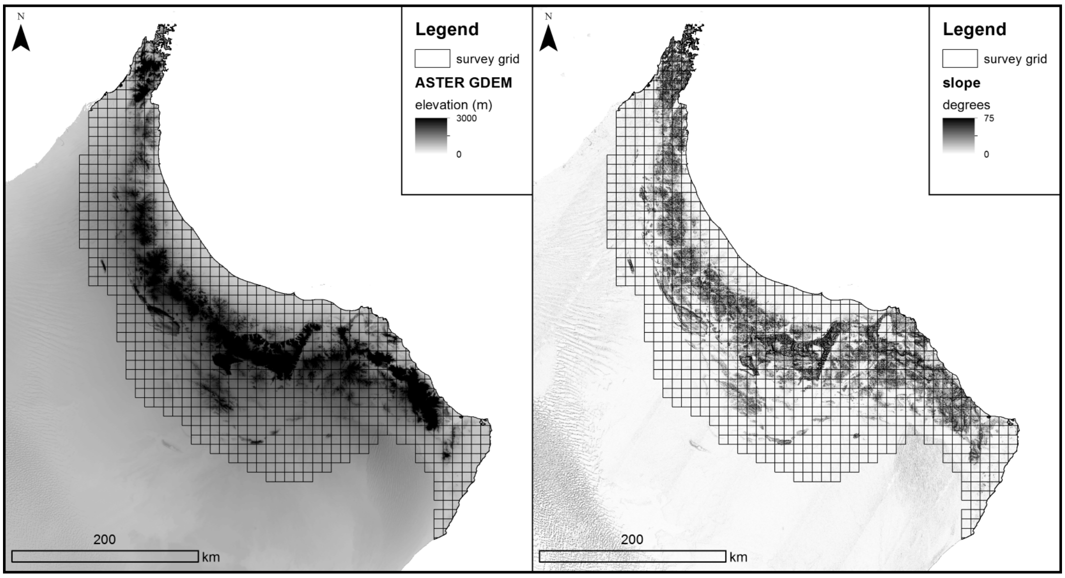


Figure 4.28: ASTER GDEM elevation and derived slope dataset used in the analysis of elevation and topography variables

The datasets generated for the hydrological analyses are all originally based on the ASTER GDEM data[13]. A hydrological model of the northern Oman Peninsula was generated in ArcGIS, including a 'flow accumulation' raster — showing the flow and accumulation of rainwater across the topography — and a map of sizeable wadi channels (Figure 4.29), which were classed by drainage area according to a WHO classification of river size (Table 4.9).

Table 4.9: WHO classification of rivers based on drainage area (Chapman 1996: table 6.1)

River Size	Drainage Area (km^2)	Example
very large river	> 1,000,000	Amazon
large river	100,000 – 1,000,000	Danube
river	10,000 – 100,000	Severn
small river*	1,000 – 10,000	Tyne
stream	100 – 1,000	-
small stream	10 – 100	-
brook**	< 10	-

*largest river class present in the northern Oman Peninsula

**not included in hydrological model

The modern settlement datasets are gazetteers downloaded from **DIVA-GIS** (http://www.diva-gis.org), consisting of place-name data prepared for the U.S. Board on Geographic Names by the National Imagery and Mapping Agency (cf. *BGN Gazetteers and Publications* 2002). Settlement place-name data for Oman — from 1983 — and the

[13]the ArcGIS **Hydrology Toolset** was used, including the Fill, Flow Direction and Flow Accumulation Tools, as well as the **Reclassify Tool** and the **Raster to Polyline Tool**

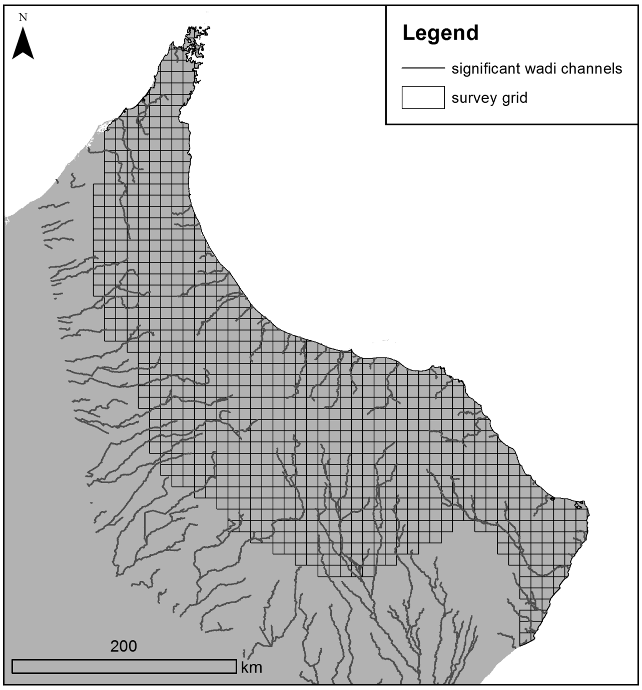


Figure 4.29: Sizeable wadi channel dataset used in the analyis of hydrology variables

U.A.E. — from 1987 — was merged to create a single dataset (Figure 4.30). The date of this data is ideal, as it mostly pre-dates the rapid development, urbanisation and spread of post-bore-hole-irrigated agriculture in the region and probably more closely reflects prehistoric conditions with a subsistence economy reliant on Late Islamic agricultural practices and fishing (cf. Wilkinson 1977: 16–32).

Coastline data, freely available at a 1:10,000,000 scale, was downloaded from **Natural Earth** (http://www.naturalearthdata.com) and used in the GIS analysis. Mapping the location of copper ore sources was more complicated — two different datasets had to be used (Figure 4.31). The Oman copper ore data was extracted from the 'Mineral Occurrence and Metallogenic Map of Oman' (Bouilly et al. 1993). This map — dated to 1993 and drawn by BRGM geologists on behalf of the Omani government — consists of a 1:1,000,000 scale plan detailing the occurrences of mineral resources within Oman. It illustrates not only the location of minerals, but also the nature, size and economic importance of the deposits. The distribution of copper ore is clearly marked in great detail. The map was georectified and the data were digitised within ArcGIS as vector data. The U.A.E. data was taken from a variety of geological and archaeological sources as no equivalent to the Oman metallogenic map was available. The main basis of this collective dataset was the maps and reports of a survey of what is now the northern U.A.E. — and was then the northern part of the Trucial States — in the 1960s; numerous minor deposits of copper ores, mainly secondary mineralisations within the Hawasina series, were reported and mapped (Greenwood 1966; Greenwood and Looney 1968). To

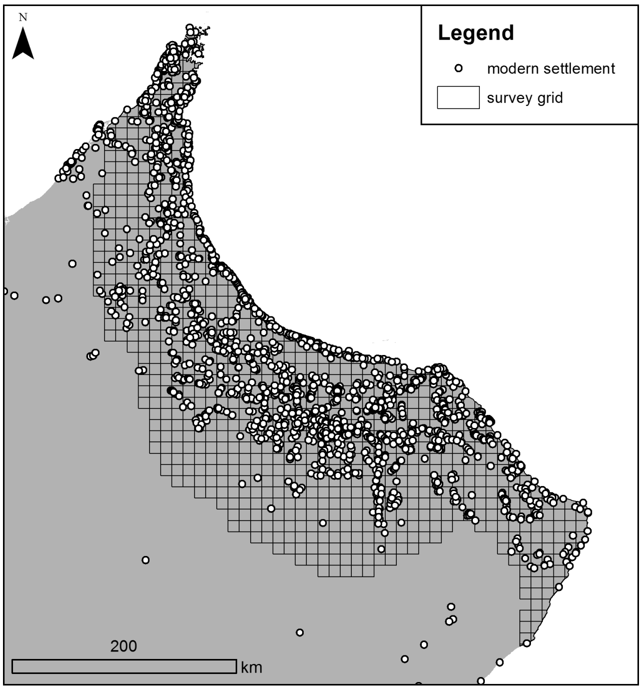


Figure 4.30: Settlement data from the 1980s used in the analysis of modern settlement variables, data from DIVA-GIS

these sites, more recent reports of copper mineral occurrences were added from geological and archaeological sources (Hassan and al-Sulaimi 1979; Weeks 2003; Hellyer and Ziolkowski 2007; Carter 2008; Kutterer 2014) — a thorough review of the literature was undertaken to ensure that the quality of the UAE data matched the Oman dataset as closely as was possible. The U.A.E. data from this wide combination of sources was amalgamated into a single GIS vector file. These two datasets for Oman and the U.A.E. are far superior in their accuracy and comprehensiveness to those gathered in the past by archaeologists examining the relationship between copper exploitation and past societies (e.g. Weeks 2003; Hauptmann 1985), and should yield accurate results when employed in the GIS analysis.

A database of every known published and unpublished Umm an-Nar site was created and imported into ArcGIS (Appendix A.2). The sites were subdivided into 'major' and 'minor' sites based on the number of fortified round-towers: sites with three or more round-towers were classified as 'major' sites (Figure 4.32). Although great pains were taken in researching the database, the dataset is unlikely to be at all comprehensive or consistent due to the general lack and patchiness of archaeological survey coverage.

Analysing the landscape using the grid squares allows the results from each variable to be displayed alongside and compared to the original Hafit tomb survey data. Moreover, it also generates an individual environmental profile for each grid square, allowing the relationship between Hafit tomb density/ubiquity and each of the variables

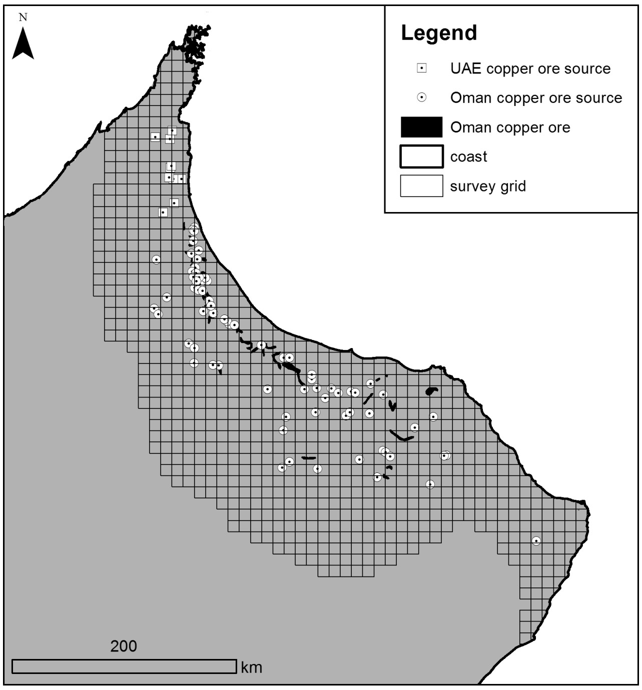


Figure 4.31: Coast and copper ore data used in the analysis of natural resource variables

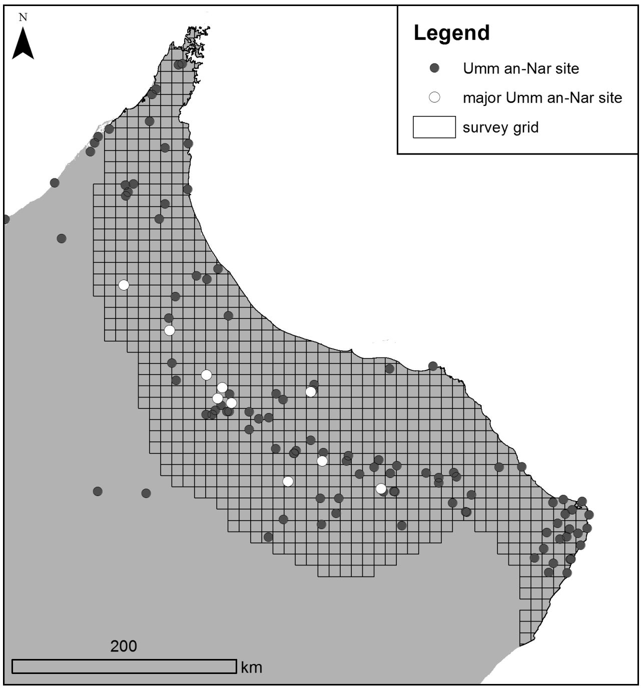


Figure 4.32: Umm an-Nar site data used in the analysis of Early Bronze Age archaeology variables (see Appendix A.2)

to be investigated in turn. To this end, all of the numerical data was imported into Microsoft Excel for further analysis — descriptive statistics were calculated and histograms were generated for each variable, controlling for the NOP-GE ordinal survey score in order to reveal patterns in Hafit tomb distribution.

4.5.2 Results

The results of the GIS analysis of the environmental and anthropogenic variables will be presented. Maps, statistics and graphs will be used in order to investigate differences in the geographical distribution of grid squares, controlling for their ordinal survey score. This will allow the different positions of '3', '2', '1' and '0' grid squares in the landscape to be modelled, thereby discovering the factors that dictated the Hafit occupation of the northern Oman Peninsula. Maps will be used, displaying the environmental variable data and a semi-transparent overlay of the original survey results. Two-dimensional histograms will be employed to compare the distribution of grid squares in related variables.

Elevation and topography

The investigation of elevation and topography-related variables intends to ascertain the relationship between Hafit tomb distribution and the terrain of the northern Oman Peninsula. The analysis of 'mean elevation' reveals a clear pattern in the differentiated distribution of grid squares that reflects the topographical areas favoured by the Hafit population (Figure 4.33). In general '1', '2' and '3' grid squares are located in low-medium mean elevation areas — few are found in either the lowest coastal areas, or in the mountain uplands. Every '3' grid square is located at the base of the Hajar Mountains, in areas of low-medium elevation surrounding the mountain range. The vast majority of '2' grid squares are also located within this zone, with a small minority drifting further towards the interior plain or the rugged eastern coast. The '1' grid squares surround the '3' and '2' squares and also appear in isolated patches in favoured topographical areas.

The 'elevation range' analysis map shows a similar pattern (Figure 4.34). There is a clear bias towards areas with a low-medium range in elevation, while completely flat regions and areas with a substantial range in elevation are largely devoid of Hafit tombs.

The pattern is defined more precisely through the statistical analysis of the two variables (Table 4.10). The mean, standard deviation and range of 'mean elevation' are the highest in '0' grid squares —- reflecting the full range of terrain types in the study area from beaches to mountain uplands. There is a downward trend in the mean, standard deviation and range as Hafit tomb numbers/ubiquity increase from '0' to '3' — the grid squares with the most tombs occupy a relatively narrow zone of several hundred metres above sea level, while grid squares with lower tomb numbers/ubiquity are distributed more loosely including in areas closer to sea level and well above 500m. This is mirrored in the statistical analysis of 'range in elevation' which shows a very similar pattern — a clear Hafit optimal zone with some variability in the landscape, but where the terrain is not too rugged or extreme.

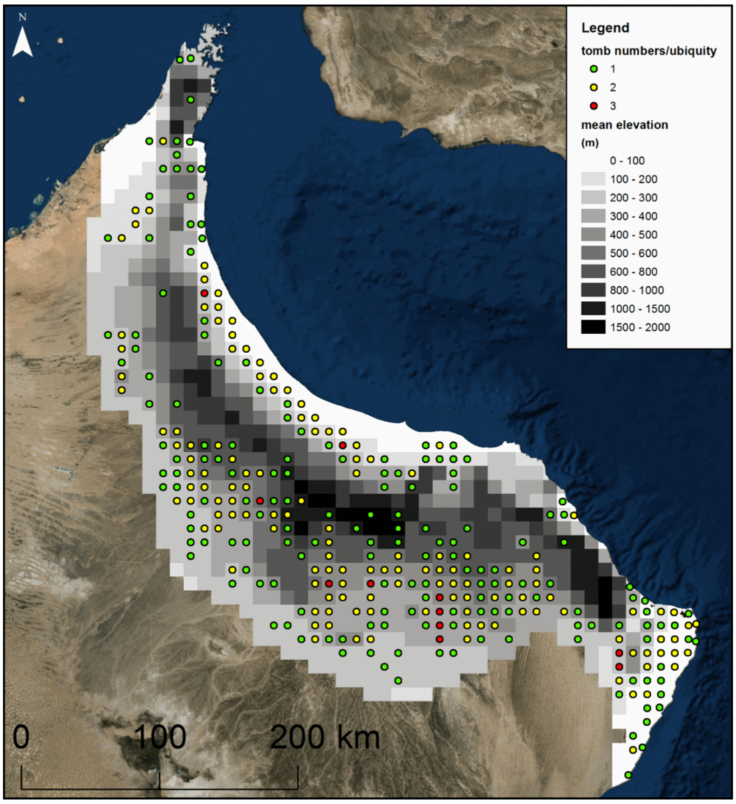


Figure 4.33: Map of the 'mean elevation' analysis overlain with the survey results

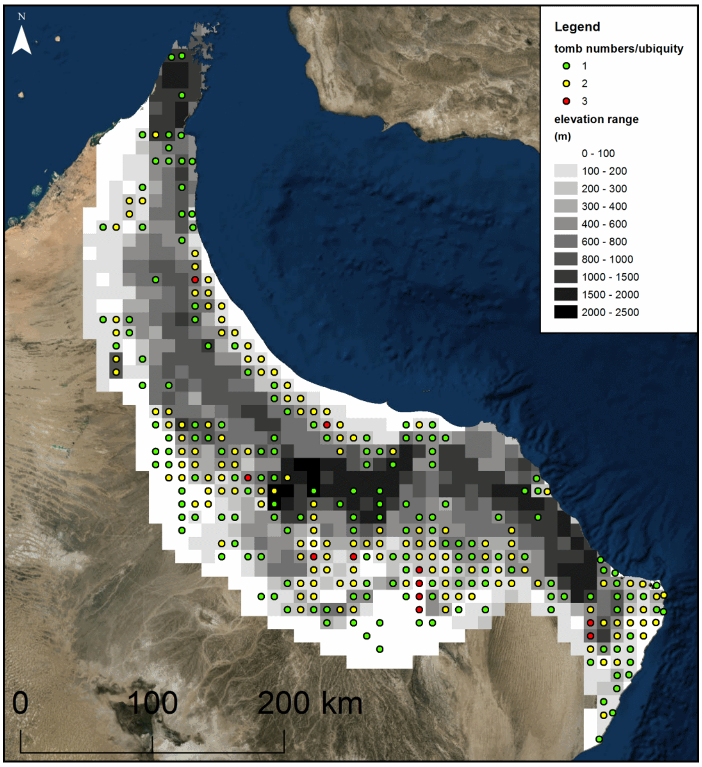


Figure 4.34: Map of the 'elevation range' analysis overlain with the survey results

Table 4.10: Descriptive statistics for 'mean elevation' and 'elevation range' by ordinal survey score

	Mean Elevation (m)				Elevation Range (m)			
	0	1	2	3	0	1	2	3
Mean	438.5	394.4	326.0	324.2	547.6	487.3	342.4	346.9
Standard Deviation	363.0	302.0	205.0	110.3	521.6	447.8	306.1	267.3
Minimum	8.1	13.3	15.3	163.8	13	28	60	82
Maximum	1993.5	1834.7	1172.7	522.1	2269	2306	2108	792

The 2D histograms demonstrate this narrowing in the low-middle values of 'mean elevation' and 'range in elevation' as Hafit tomb numbers/ubiquity increases (Figure 4.35). The analysis of these two variables demonstrate a narrow Hafit preference for certain topographical areas in the landscape.

When summarised over large areas, as with the grid squares, mean and max slope are variables that indicate the overall ruggedness of the landscape rather than the gradient of the land surface. These variables also demonstrate a narrowing distribution as Hafit tomb numbers/ubiquity increases (Figure 4.36). The statistics support this observation — from '0' to '3' the mean, range and standard deviation of 'mean slope' and 'max slope' decrease (Table 4.11), centering on values of low-middle slope that exclude both the flattest and most rugged terrain.

Table 4.11: Descriptive statistics for 'mean slope' and 'max slope' by ordinal survey score

	Mean Slope (°)				Max Slope (°)			
	0	1	2	3	0	1	2	3
Mean	8.1	6.1	3.5	2.8	33.2	33.1	29.8	27.2
Standard Deviation	7.3	5.6	3.1	2.2	23.5	19.1	16.1	16
Minimum	0.6	0.6	0.7	0.9	1.7	3	3.4	6.4
Maximum	25.2	24.2	15.4	7.7	76.1	76.6	73.1	50.7

The 2D histogram illustrates this narrowing Hafit preference for the low-middle to middle range of values (Figure 4.37).

The analysis of the elevation and topography variables demonstrate that high tomb numbers/ubiquity grid squares are located within specific areas of the landscape, with increasing variety in the terrain of grid squares boasting fewer tombs.

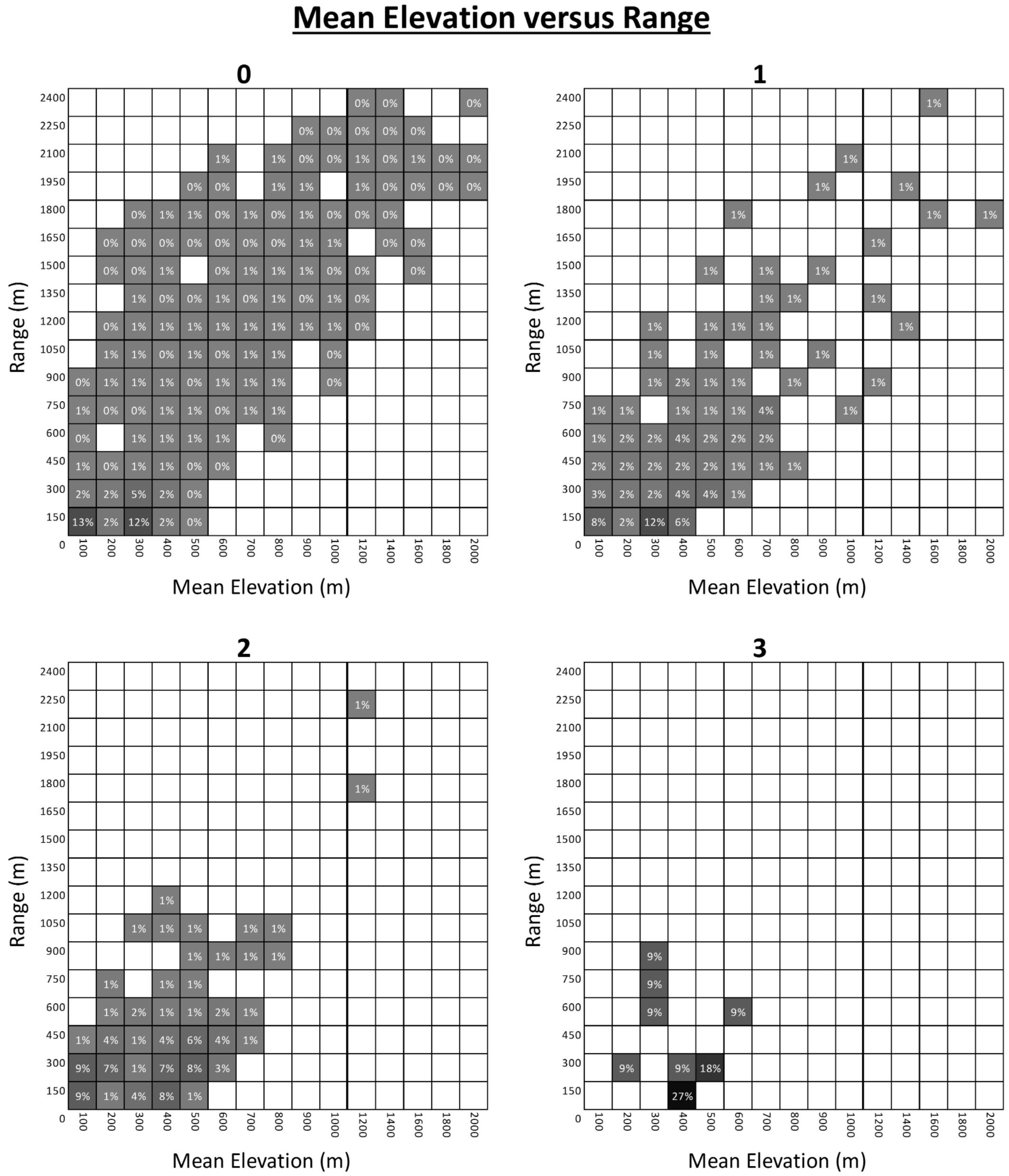


Figure 4.35: 2D histogram: 'mean elevation' versus 'elevation range' by ordinal survey score

Hydrology

Analysis of the hydrological variables should reveal the nature of the relationship between Hafit tomb distribution and the fresh water sources of the northern Oman Peninsula. The 'maximum flow accumulation' map — which calculates the size of the drainage area of the largest water course in each survey square — demonstrates a strong relationship with Hafit tombs (Figure 4.38). The vast majority of '3' and '2' grid squares contain — or are immediately adjacent to — a wadi with a medium to large drainage area. Most of the '1' grid squares immediately surround these areas, or are in isolated positions in close

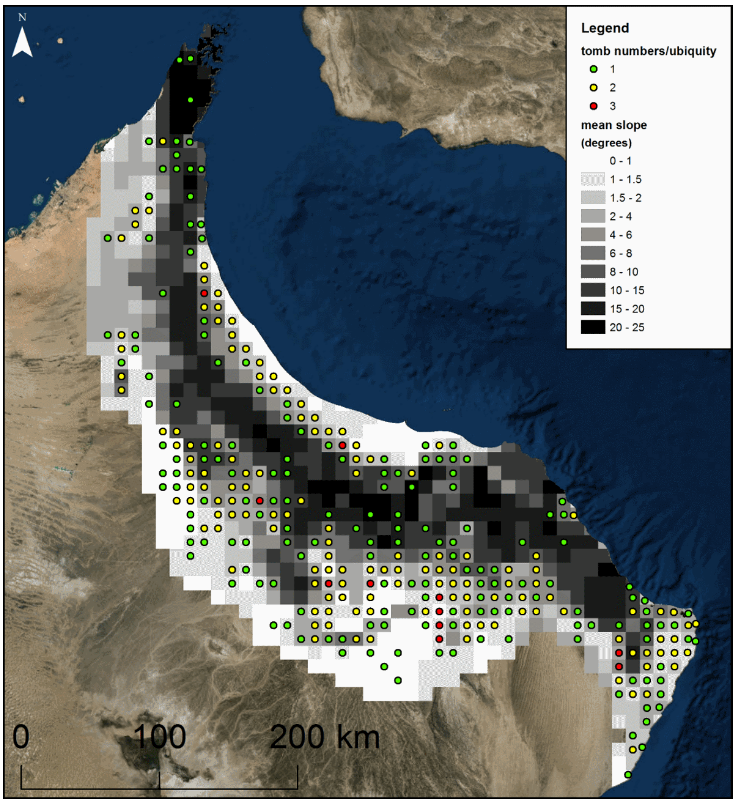


Figure 4.36: Map of the 'mean slope' analysis overlain with the survey results

proximity to their own sizeable water source. Hafit tombs are not found in the middle of arid areas that lack sizeable wadis. However, interestingly they are also only rarely found in close proximity to the very largest water channels in the hydrological model.

The 'mean distance to sizeable wadi channel' analysis yielded similar results (Figure 4.39). The majority of '3' and '2' grid squares, and a great many of the '1' squares, are found at a low/low-medium mean distance from a sizeable wadi channel. Hafit tombs are only very rarely found at a great distance from potential sources of surface or groundwater.

Statistical analysis of the two hydrological variables further underlines the strength of the tomb-wadi relationship (Table 4.12). As tomb numbers/ubiquity increases the mean, minimum and standard deviation of 'max flow accumulation' (i.e. the size of the largest wadi in a grid square) increase markedly. Conversely the 'mean distance to sizeable wadi' is significantly smaller in '3' and '2' grid squares.

The 2D histograms graphically display the relationship between Hafit tomb distribution and the hydrology of the northern Oman Peninsula (Figure 4.40). Grid squares with greater tomb numbers/ubiquity are closer to wadi channels on average, and are more likely to contain large wadis. Almost two thirds of '3' grid squares contain a wadi equivalent in size to a small river, and are on average less than 4km from a sizeable wadi channel.

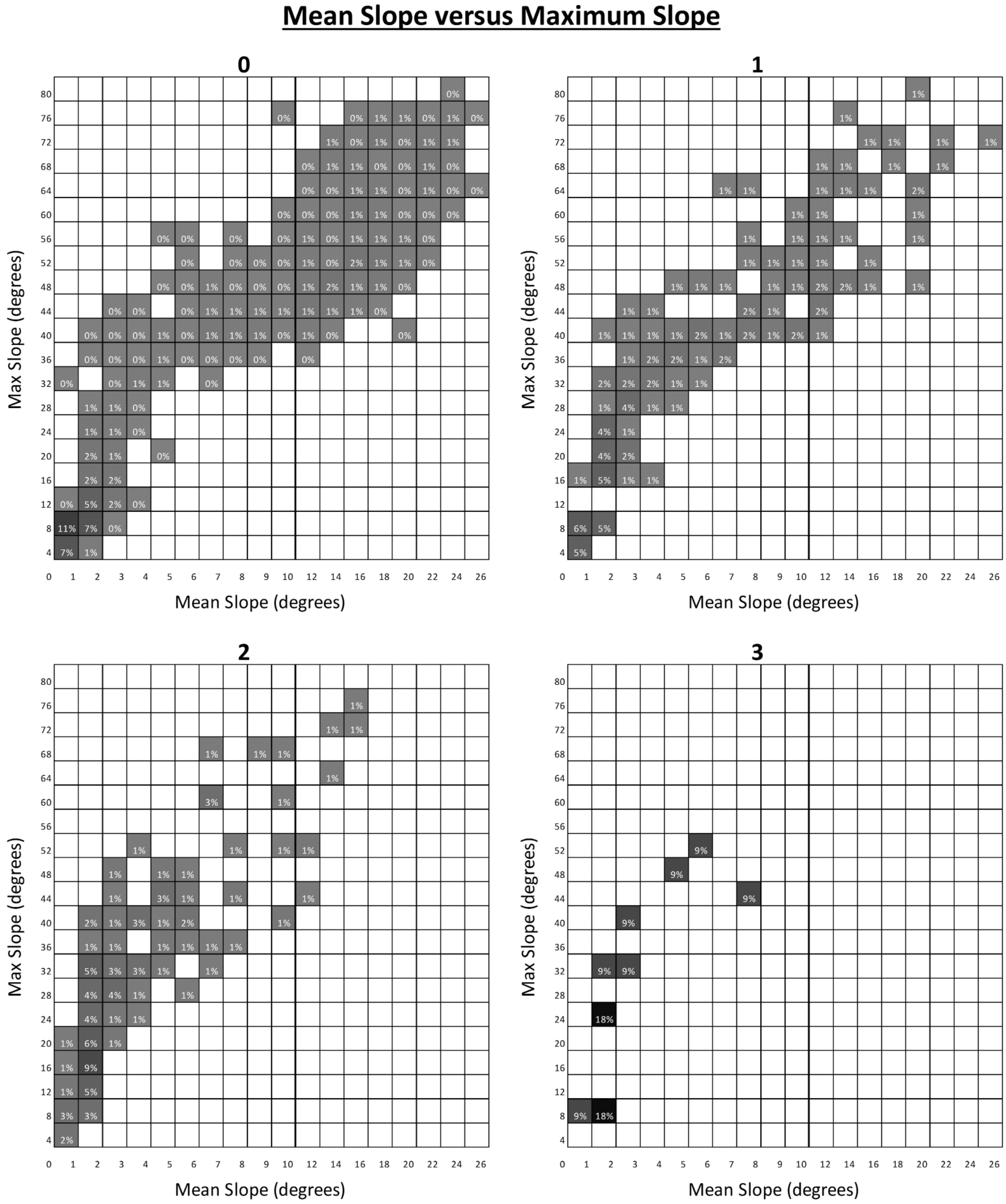


Figure 4.37: 2D histogram: 'mean slope' versus 'max slope' by ordinal survey score

Table 4.12: Descriptive statistics for 'max flow accumulation' and 'mean distance to sizeable wadi' by ordinal survey score

	Max Flow Accumulation (sq-km)				Mean Distance to Wadi (km)			
	0	1	2	3	0	1	2	3
Mean	478.8	583.9	709.1	1414.8	9.1	7.8	5.4	3.8
Standard Deviation	828.7	971.7	1008.7	1553.6	6.5	6.3	4.0	3.9
Minimum	0.4	1.5	10.1	79.7	0.5	1.2	1.2	1.2
Maximum	6664.6	6540.3	6228.5	5556.9	38.8	35.2	20.1	13.9

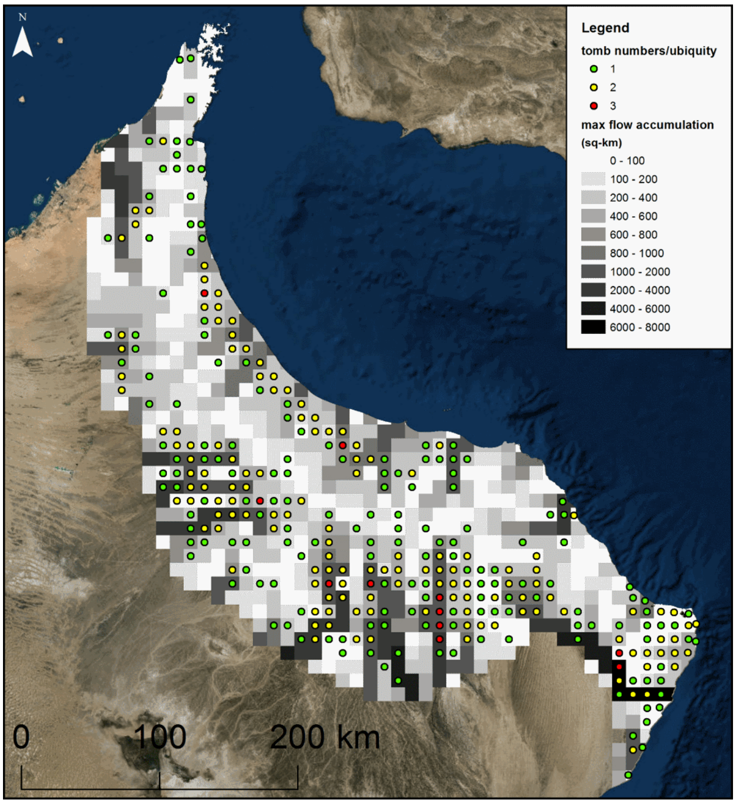


Figure 4.38: Map of the 'max flow accumulation' analysis overlain with the survey results

Analysis of the hydrological variables demonstrate a strong relationship between the distribution of Hafit tombs and the location and size of the wadi systems of the northern Oman Peninsula.

Modern settlement

The modern settlement variables reveal an interesting relationship between Hafit tomb distribution and recent settlement patterns. The 'mean distance to modern settlement' analysis suggests that there is little overlap between Hafit occupation areas and recent settlement patterns (Figure 4.41). Although not found at the further distances from modern settlements, '1', '2' and '3' grid squares are neither very proximate to them. Grid squares boasting high tomb numbers/ubiquity are generally at a low to middling distance from modern settlements.

Interestingly the analysis of 'mean density of modern settlement' demonstrates the opposite pattern (Figure 4.42). '3' and '2' grid squares are located in the lower-density, fringe areas. Generally, tombs are located neither in areas completely devoid of modern settlement, nor in high-density areas.

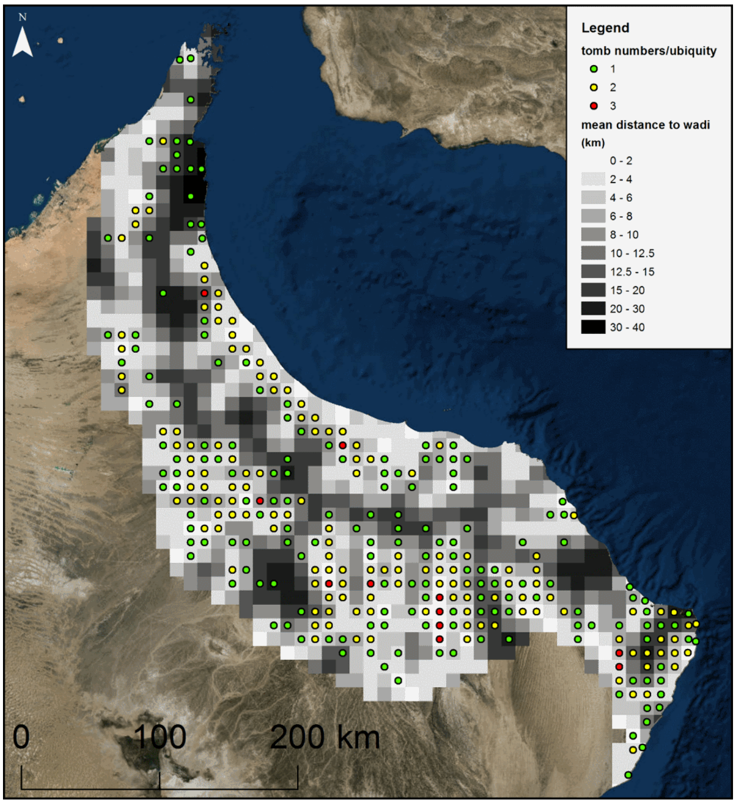


Figure 4.39: Map of the 'mean distance to sizeable wadi channel' analysis overlain with the survey results

These somewhat opposing observations are supported by the statistical analysis (Table 4.13). As tomb numbers/ubiquity increases, the mean distance to the nearest modern settlement declines; moreover the maximum, range and standard deviation decrease while the minimum increases —- demonstrating tight clustering. The pattern is almost identical with the 'mean density of modern settlement' variable. This suggests a Hafit preference for land that is now at a low-middle distance from recent settlement, but is also well outside the most densely settled areas.

Table 4.13: Descriptive statistics for 'mean distance to settlement' and 'mean density of settlement' by ordinal survey score

	Mean Distance to Settlement (km)				Mean Density of Settlement (settlements/sq-km)			
	0	1	2	3	0	1	2	3
Mean	8.2	7.9	6.7	4.4	0.025	0.022	0.016	0.019
Standard Deviation	9.0	7.0	4.9	1.9	0.033	0.033	0.017	0.015
Minimum	0.4	1.1	1.4	1.9	0	0	0	0.005
Maximum	50.3	32.9	30.2	7.7	0.252	0.240	0.094	0.043

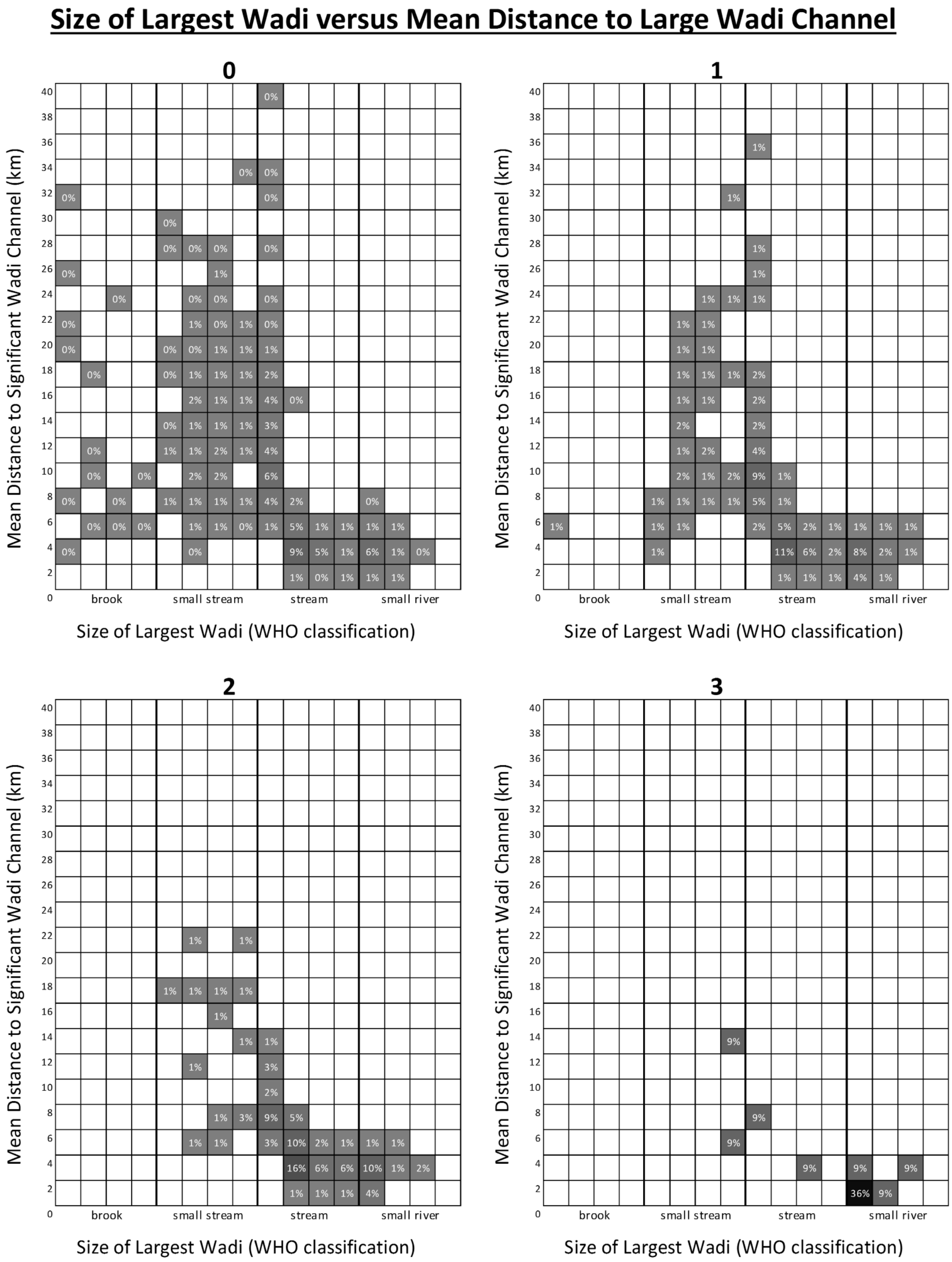


Figure 4.40: 2D histogram: 'wadi size' versus 'mean distance to sizeable wadi' by ordinal survey score

The 2D histograms strongly underline these observations and statistics (Figure 4.43). As Hafit tomb numbers/ubiquity increases, 'mean distance to modern settlement' and 'mean density of modern settlement' both decrease.

The analysis of the modern settlement variables suggests that Hafit tombs are most likely to be located on land that is a relatively short distance from modern settlements, but not in the areas that were most attractive to the recent population.

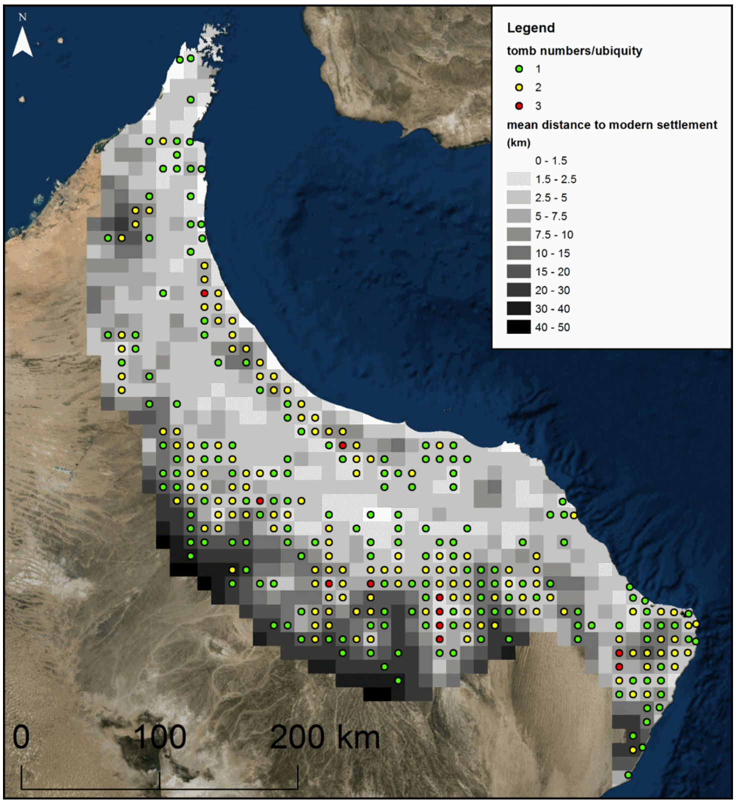


Figure 4.41: Map of the 'mean distance to modern settlement' analysis overlain with the survey results

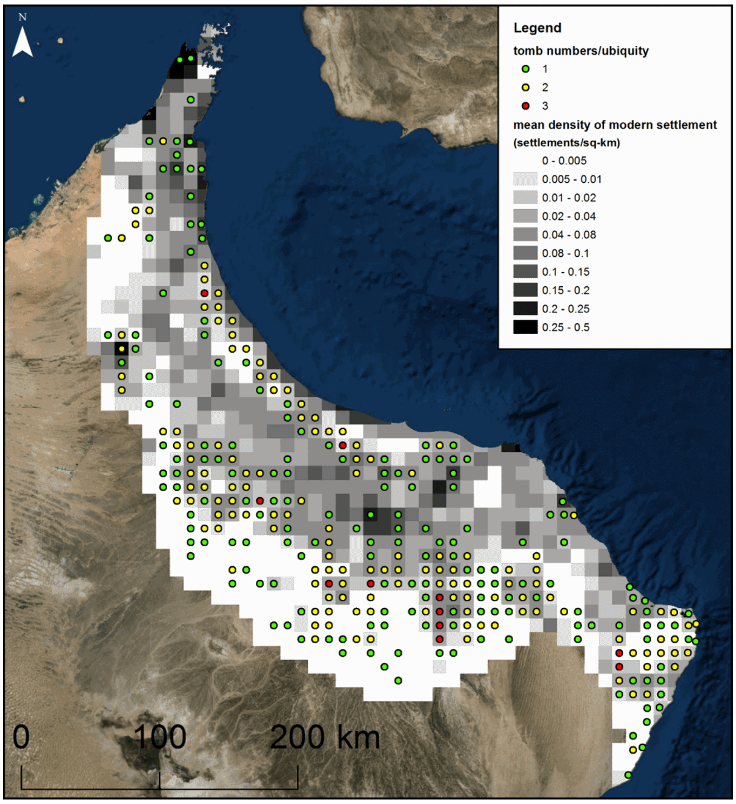


Figure 4.42: Map of the 'mean density of modern settlement' analysis overlain with the survey results

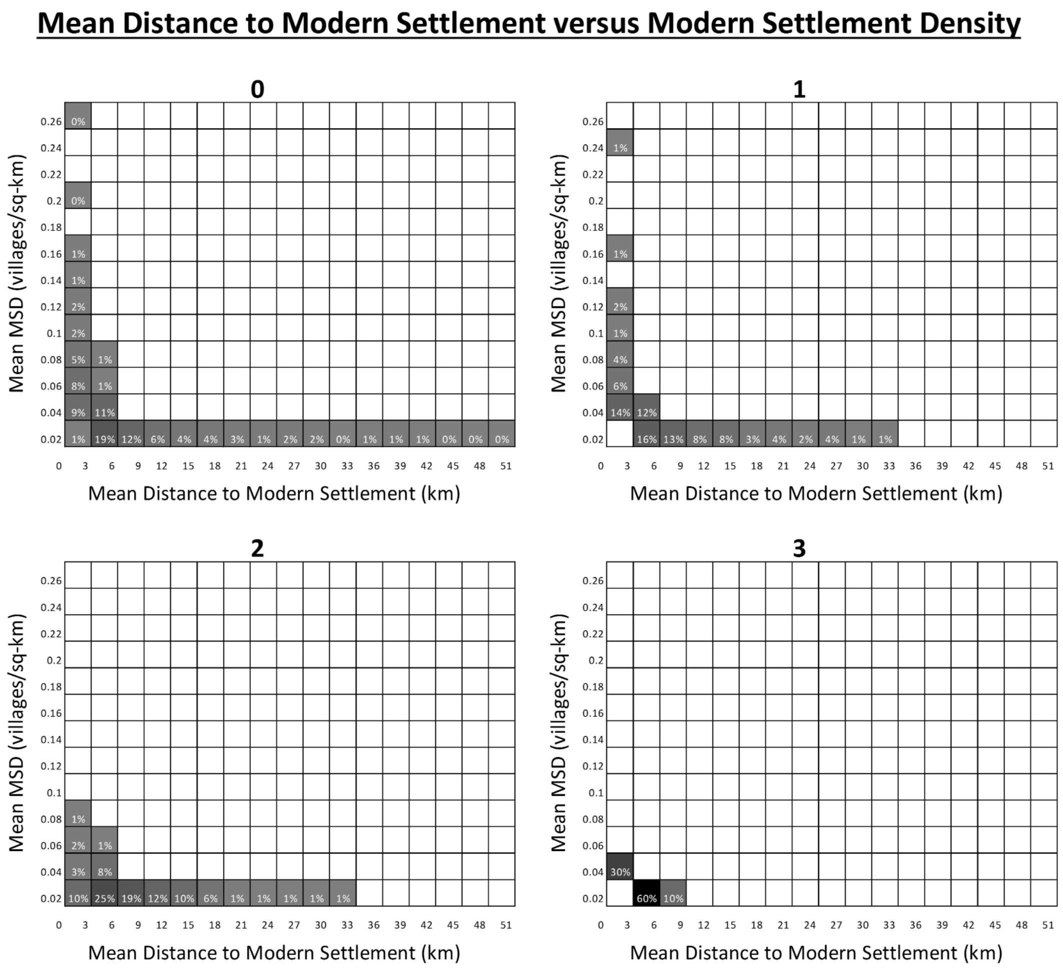


Figure 4.43: 2D histogram: 'mean distance to modern settlement' versus 'mean density of modern settlement' by ordinal survey score

Natural resources

Analysis of the natural resources variables suggests that different resources show differing relationships with the Hafit tomb distribution. The 'mean distance to coast' analysis reveals a varied relationship between the Hafit population and the coast (Figure 4.44). There are three major groupings of Hafit tombs, each presenting a different relationships with coastal areas. The inland cluster of Hafit tombs on the southwestern side of the Hajar Mountain range is the largest, and is a very long way from the coast. In contrast, the sizeable eastern Sharqiyah cluster is immediately adjacent to the rugged Ja'alan coastline. Finally, the Batinah group is found in close proximity to the sea, running parallel to but never touching the coast itself.

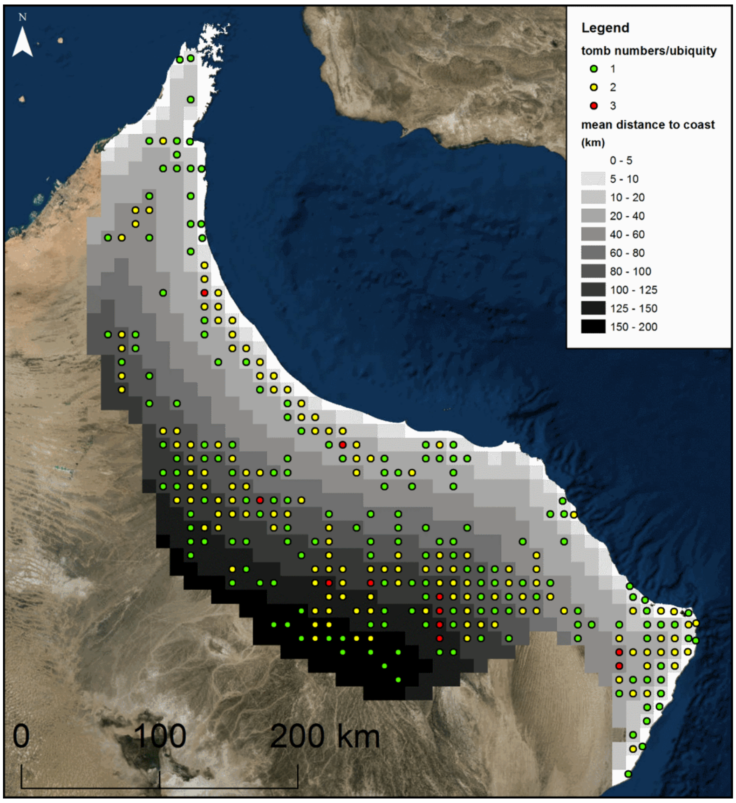


Figure 4.44: Map of the 'mean distance to coast' analysis overlain with the survey results

In contrast, the 'mean distance to copper ore' analysis reveals a strong relationship between the distribution of Hafit tombs and copper ore (Figure 4.45). '3' and '2' grid squares are frequently only a short-middle distance from copper ore, or even contain a source of it.

The statistical analysis of these two variables supports these observations (Table 4.14). With regards to 'mean distance to coast', generally grid squares with high tomb numbers/ubiquity are situated further away from the coast, although the high standard deviation and low minimum demonstrate significant variation. In contrast, generally

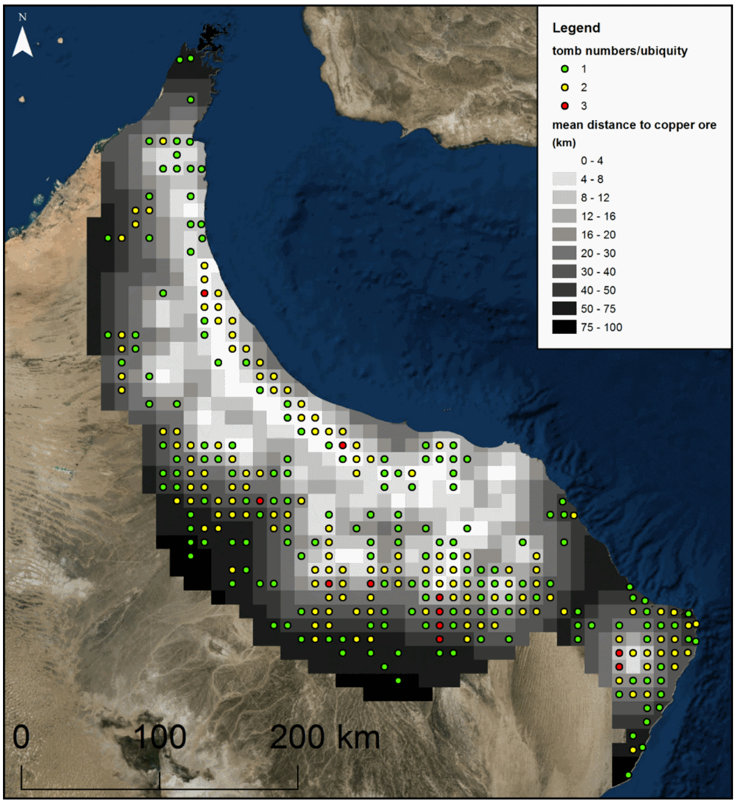


Figure 4.45: Map of the 'mean distance to copper ore' analysis overlain with the survey results

tomb numbers/ubiquity is proportional to proximity to copper ore. On average the mean distance to a copper ore source of a '0' grid square is seventy percent greater than a '3' square. Not only does the mean drop from '0' to '3', but so does the standard deviation and maximum — strongly suggesting that the correlation is not the result of outliers skewing the data.

Table 4.14: Descriptive statistics for mean distance to coast' and 'mean distance to copper ore source' by ordinal survey score

	Mean Distance to Coast (km)				Mean Distance to Cu Source (km)			
	0	1	2	3	0	1	2	3
Mean	59.1	67.3	70.5	86.5	30.9	27.7	22.7	18.3
Standard Deviation	51.2	49.8	45.6	45.5	23.2	20.5	16.1	13.5
Minimum	0.3	1.0	1.7	16.2	0.8	1.1	1.2	1.8
Maximum	185.4	171.8	166.3	133.5	97.6	84.8	66.4	42.8

The 2D histograms demonstrate the widespread variation in Hafit tomb distribution with regards to the coast, and the much stronger spatial relationship with copper ore sources (Figure 4.46). Almost two thirds of '3' grid squares and 41% of '2' squares are on average 20km or less from a copper ore source, compared to just over a third of '0' grid squares.

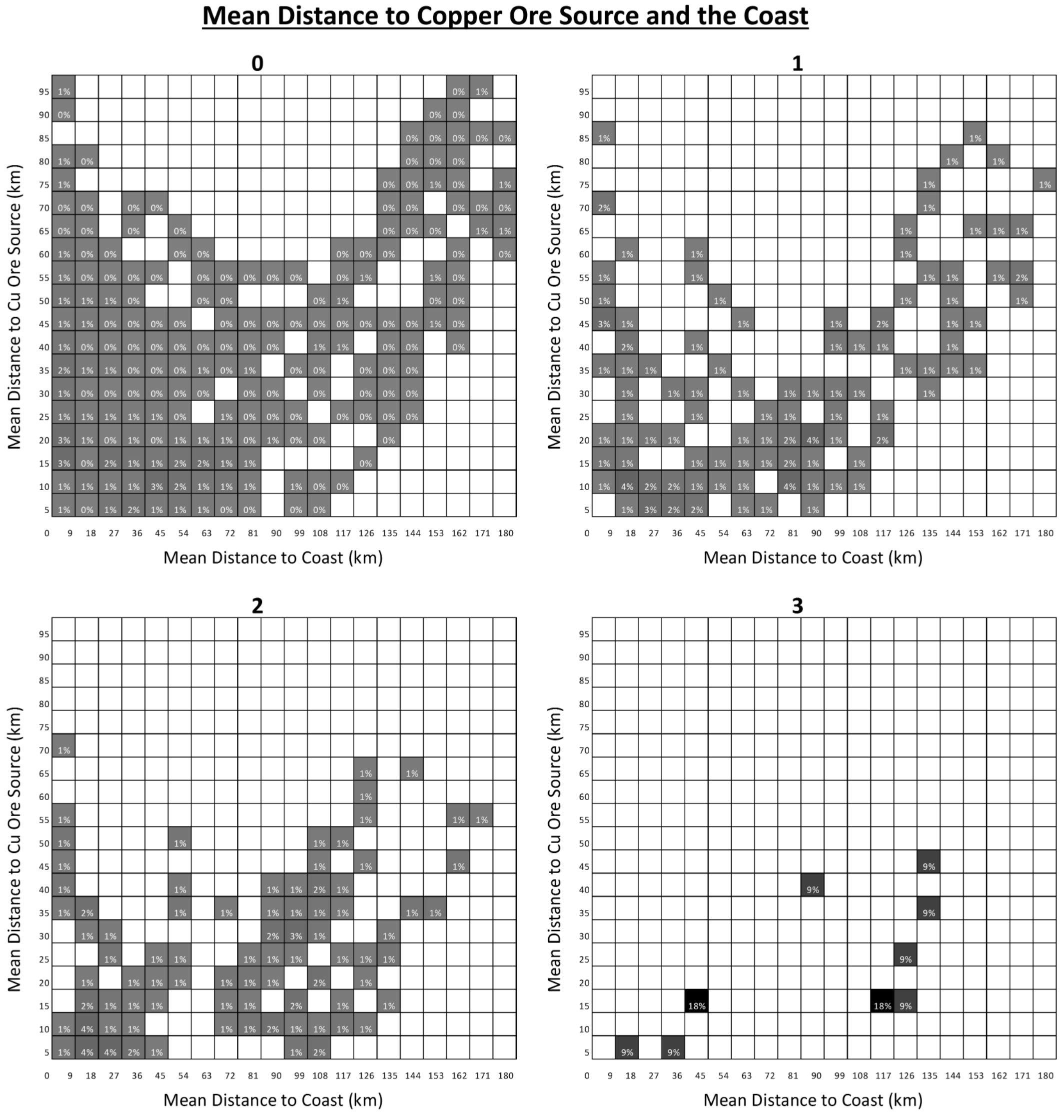


Figure 4.46: 2D histogram: 'mean distance to coast' versus 'mean distance to copper ore source' by ordinal survey score

Analysis reveals a complex relationship between Hafit tombs and the coast, and a much stronger link to copper ore sources.

Early Bronze Age archaeology

Assessing the relationship between the distribution of Hafit tombs and the two Early Bronze Age archaeological variables reveals a spatial link between the funerary structures and the location of the later Umm an-Nar sites. The 'mean distance to Umm an-Nar sites' analysis suggests some correlation between the variable and Hafit tomb numbers/ubiquity (Figure 4.47). There is a clear overlap between the distribution of Hafit tombs and Umm an-Nar sites, with '3' and '2' squares generally located at close proximity to the later sites. Although there are exceptions with some areas of high Hafit tomb numbers/ubiquity being found away from Umm an-Nar sites and other areas boasting Umm an-Nar sites lacking Hafit tombs, these are in the minority. The former may even reflect the incomplete nature of the current archaeological record.

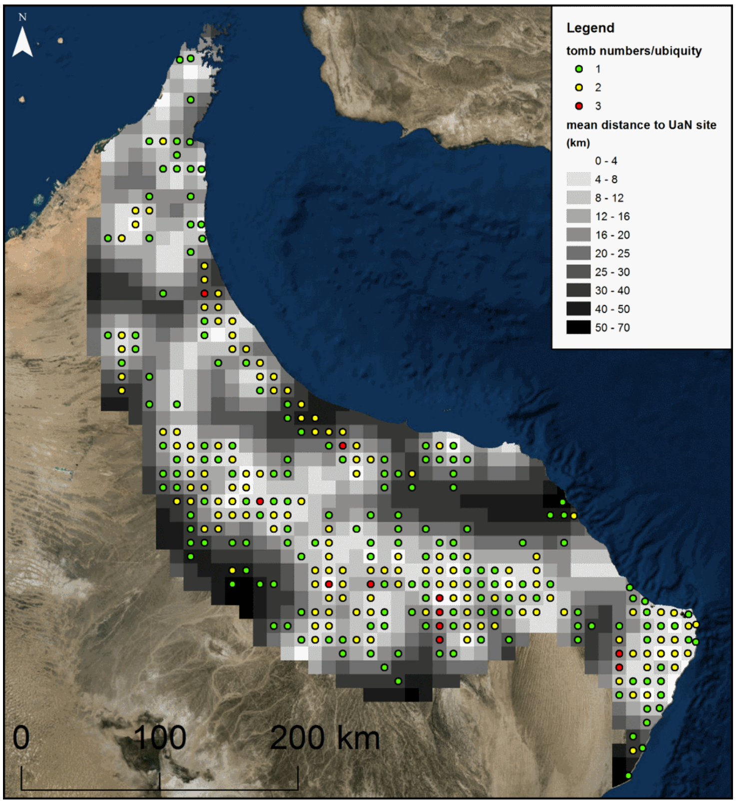


Figure 4.47: Map of the 'mean distance to Umm an-Nar site' analysis overlain with the survey results

Similarly, the analysis of the 'mean distance to major Umm an-Nar sites' variable suggests a relationship between Hafit tomb distribution and the location of the most important settlements of the later part of the Early Bronze Age (Figure 4.48). In the majority of cases, '3' and '2' grid squares are found in close proximity to a major Umm an-Nar site. The major exceptions are in eastern Sharqiyah — which has plenty of Umm an-Nar sites but lacks round towers — and the Batinah which lacks archaeological exploration.

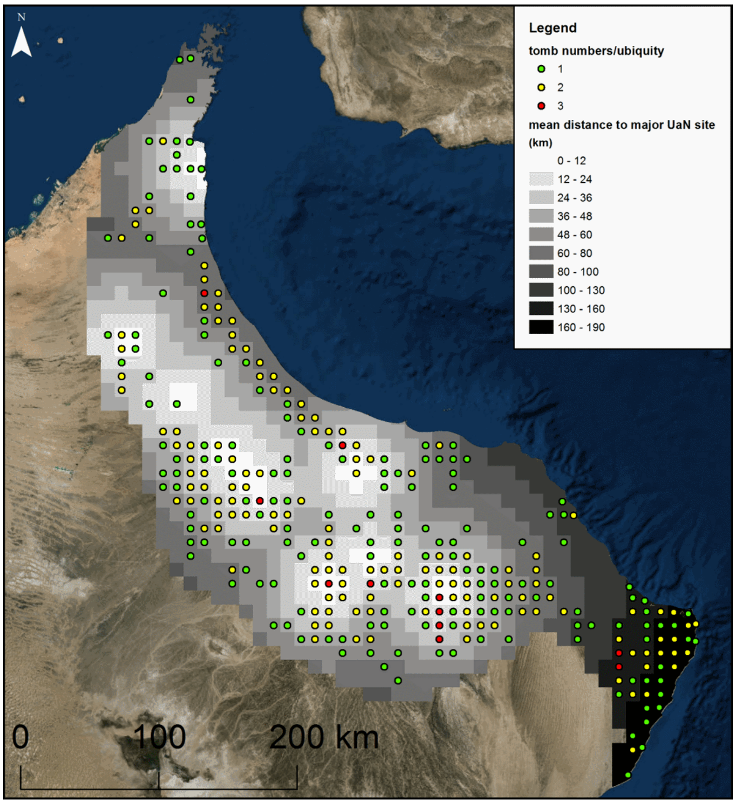


Figure 4.48: Map of the 'mean distance to major Umm an-Nar site' analysis overlain with the survey results

The statistical analysis of these two variables supports these observations (Table 4.15). Generally, the greater the Hafit tomb numbers/ubiquity the closer the Umm an-Nar sites and major Umm an-Nar sites — '1' and '0' grid squares are located further from these sites on average.

Table 4.15: Descriptive statistics for 'mean distance to Umm an-Nar site' and 'mean distance to major Umm an-Nar site' by ordinal survey score

	Mean Distance to UaN Site (km)				Mean Distance to Major UaN Site (km)			
	0	1	2	3	0	1	2	3
Mean	22.4	17.0	12.0	14.1	59.7	59.6	54.4	42.9
Standard Deviation	12.1	11.1	9.8	7.8	35.7	47.9	48.7	49.9
Minimum	3.0	2.2	2.4	3.0	4.2	3.6	4.0	4.0
Maximum	68.4	58.4	48.4	28.1	187.9	188.5	185.6	139.2

The 2D histograms show this relationship in greater detail (Figure 4.49). A sizeable majority of ‘3’ and ‘2’ grid squares are within 20km of an Umm an-Nar site, and almost three-quarters of the ‘3’ grid squares and nearly half of the ‘2’ squares are within a mean distance of 24km from an Umm an-Nar site and 40km from a major site. The graphs also show the significant variation in ‘mean distance to major Umm an-Nar site’, with a sizeable minority of ‘3’ and ‘2’ grid squares situated over 120km away.

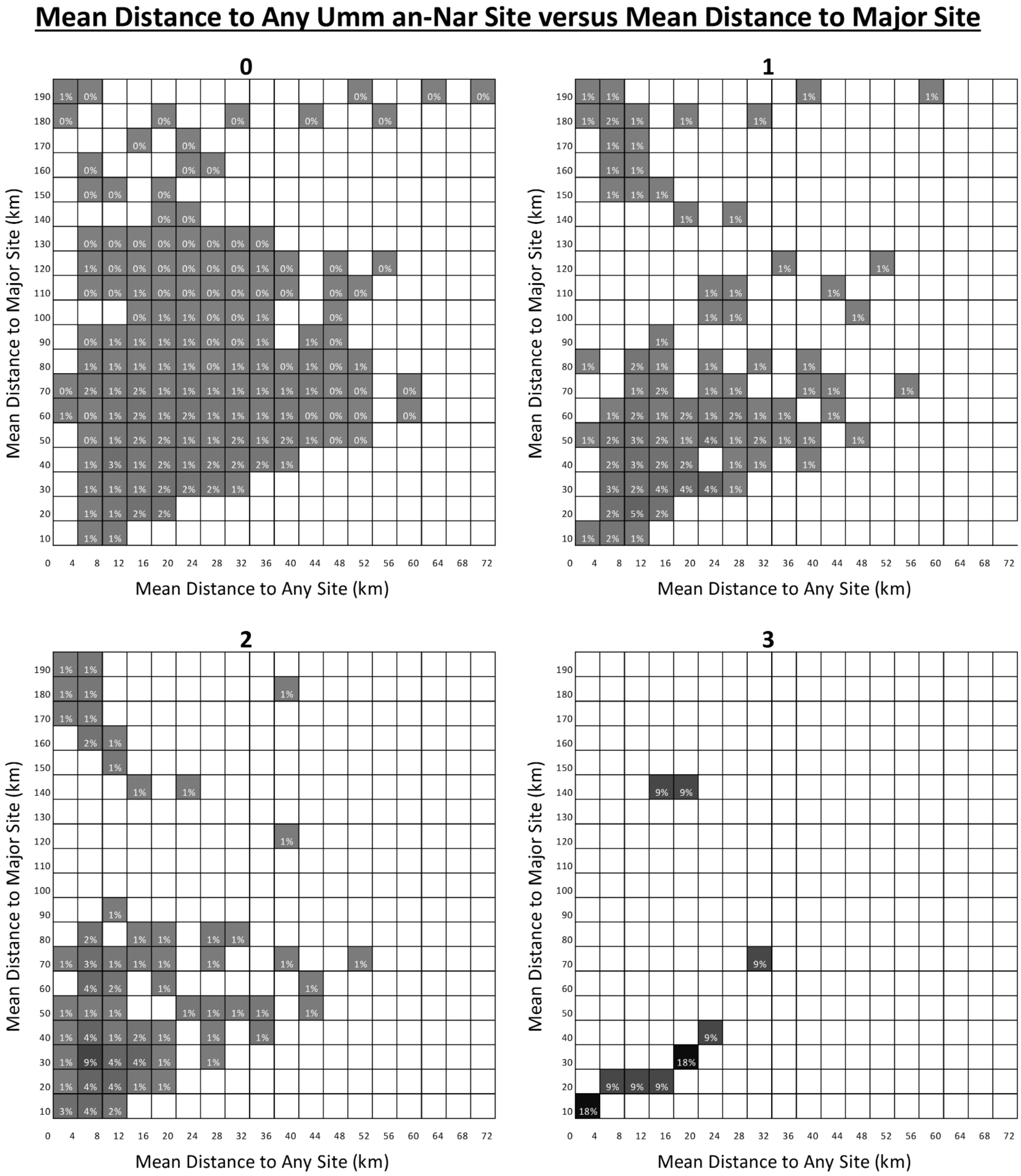


Figure 4.49: 2D histogram: ‘mean distance to Umm an-Nar site’ versus ‘mean distance to major Umm an-Nar site’ by ordinal survey score

In general, there is a spatial link between the distribution of Hafit tombs and later Early Bronze Age sites — the ‘mean distance to Umm an-Nar site’ shows a clearer correlation, while ‘mean to distance to major Umm an-Nar site’ boasts a stronger relationship. There are a significant number of exceptions, some of which may be the result of the incomplete Umm an-Nar site dataset.

4.5.3 Analysis & discussion

Having examined the relationship between Hafit tomb numbers/ubiquity and the environmental and anthropogenic landscape, the results will be analysed to shed light on the nature of Hafit society. This is worthwhile for its own sake, but will also generate a general picture of Hafit society in the northern Oman Peninsula to compare with more detailed analyses of Batinah Hafit tombs in later chapters.

Analysis of the elevation and topography variables revealed a pattern in Hafit tomb distribution. As Hafit tomb numbers/ubiquity increased, the ‘mean elevation’, ‘elevation range’, ‘mean slope’ and ‘max slope’ of the survey squares showed a narrowing range focused on the low-medium side of each variable. Topographically these are areas that are above sea-level but not overly elevated (i.e. between 200 and 500m), and that show low to middling ruggedness of terrain. This corresponds to the foothills at the base of both sides of the Hajar Mountains — the tombs show minimal penetration of the mountain uplands, or the coastal and interior plains. Only in one region, on the easternmost coastline of the Oman Peninsula, do these foothills meet the coast — elsewhere where there is a lengthy coastal plain, such as the Batinah, or where much steeper and more elevated upland areas drop into the sea, such as in the Muscat and Musandam Governorates, Hafit tombs are found only in very small numbers. Although the analysis of these variables demonstrates a clear preference for a certain terrain type, the reason behind it is unclear — what was attractive about these areas to Hafit populations? This question will be discussed in the next section.

The analysis of the hydrological variables reveal a strong relationship between the distribution of Hafit tombs and the hydrology of the northern Oman Peninsula. ‘3’ and ‘2’ grid squares generally show a low mean distance to wadis, and frequently contain or neighbour substantial wadi channels with a medium-high drainage area. Oman’s wadis provide a fresh water supply for at least part of the year, and this may have been more pronounced in the wetter conditions of the Hafit period, but they also provide grazing for livestock and a navigable route through the terrain, together these factors appear to have influenced the Hafit occupation of the landscape. The size of the drainage area of a wadi was not the sole factor in determining the extent to which it was exploited by the Hafit population. Tombs are only rarely found in close proximity to the very largest of the modelled channels — generally tomb distribution dwindles as the wadis flow out of the foothills and into the coastal and interior plains. Most likely this is explained by a drop in the water table that is correlated with the topography; what was originally surface flow in the mountains and foothills rapidly sinks beneath the sediments and gravels as the water moves into the alluvial plains. Despite draining large areas, what surface channels there are were formed during flash floods, and for the vast majority of time, water is confined to deep beneath the ground. However, it is also important to note that the absence of Hafit tombs — particularly where there is a lack of elevated areas on which to site them — does not necessarily preclude exploitation by the Hafit population.

The relationship between the distribution of Hafit tombs and modern settlement is intriguing. Although '3' and '2' grid squares are the closest to modern settlements, they also boast the lowest density of recent settlements. Hafit tombs are absent, or found in only very low numbers, where modern settlement is most dense: on the coast and in the upper foothills right at the base of the mountains, but are much more common near large wadi channels, where villages are distributed in low but consistent numbers. Modern settlement patterns reflect the economic strategy of a relatively sophisticated agrarian subsistence economy. The lack of overlap in areas of high Hafit tomb density and recent settlement may suggest that Hafit landscape occupations patterns are incomparable and therefore the Hafit population is unlikely to have been made up of sedentary farmers. However, these differences can also be explained through differences in agricultural method and practice, that Hafit agriculture was relatively unsophisticated and, in particular, lacked the *aflaj* of the Iron Age and Islamic period. It is also important to be mindful of the effect that modern settlement has had on Hafit funerary archaeology — that Hafit tombs in close proximity to recent towns and villages are more likely to have been destroyed, biasing the results of the analysis. Moreover, Hafit emphasis may have changed as the period progressed — the tomb dataset is a palimpsest rather than a discrete and static funerary snapshot.

The link between the distribution of Hafit tombs and the coast is a complex one, reflecting the existence of a variety of relationships in different regions. In some cases the coast is likely to have played a major role in Hafit subsistence strategies, in others it could potentially have been a significant resource, while elsewhere it can only have played an indirect role in the economy. A discussion of the precise role that the coast played, whether as a rich food resource, as a means of accessing local and regional trade, or as a combination of the two, can only be speculation. It is also possible that different burial methods may have been employed by the Hafit population in coastal areas that lacked stone to build and elevated areas to place tombs. The spatial relationship between Hafit tombs and copper ore sources is much stronger and much less ambiguous. Hafit tombs are concentrated in areas that contain or neighbour copper ore sources — the mean distance of '3' grid squares is almost half that of '0' squares. This is either a remarkable coincidence, or it highlights the importance of the metal and the widespread exploitation of copper ore sources during the Hafit period. If coincidental, it may result from overlap between the occurrence of copper ore in the ophiolite formations beneath the Hajar Mountains, and a Hafit preference for the nearby foothills for different reasons that are unconnected.

There does appear to be a spatial overlap between the distribution of Hafit tombs and that of Umm an-Nar sites. The densest concentrations of the tombs are generally found at a low-middle distance from a later Early Bronze Age site. Moreover, in the majority of cases — there are exceptions — '3' and '2' grid squares are located in close proximity to a major Umm an-Nar site. The relationship appears to be close enough to suggest that similar areas were exploited in both periods, but not close enough to suggest unbroken continuation of settlement — the mean distance between survey squares with Hafit tombs and the nearest Umm an-Nar site is still between 12 and 17km, while that between '3' grid squares and major sites is 42km. This relationship is consistent perhaps with a continuation in the population but a change in subsistence strategies, perhaps the settling of a nomadic pastoralist population into sedentary arable farming. However, it is vital to remember that while the Hafit tomb dataset is fairly comprehensive, the Umm an-Nar site dataset — based on the literature — is incomplete and this may bias the analysis.

While so far it has only been mentioned in passing — and will be discussed in much greater detail later (Chapter 5.4) — the Hafit tomb distribution of the Batinah is often inconsistent with that of the northern Oman Peninsula as a whole. In terms of the elevation and topography, the Batinah is unremarkable: '3' and '2' grid squares show a clear preference for the low foothills south and west of the large coastal plain. However, occupation of this zone is unusual. Unlike in other areas — especially the inland agglomerations on the southwestern side of the Hajar Mountains — Hafit tombs are not distributed 'vertically', running north-south from the lower foothills into lower upland areas, but rather show a 'horizontal' distribution, running along the lower foothills parallel to the line of the coast and the mountains in an unbroken band. Furthermore, their relationship to the hydrology is unusual — rather than running along the course of the major wadis, the 'Batinah band' runs perpendicular to the wadis, crossing them at points, but not showing a significant concentration in tombs as it does so. The relationship between the distribution of Hafit tombs and modern settlement is marked on the Batinah — modern settlements are particularly numerous on the Batinah coast and not sparse in the high foothill and low uplands zones; in contrast, the band of Hafit tombs lies exactly between these two areas, where there is a pronounced dearth of recent villages. The Batinah Hafit tombs have a very strong relationship with copper ore, they are consistently observed in areas that are only a short distance from these resources.

This is atypical; in other areas while invariably part of a large cluster of Hafit tombs will be close to a copper source, much of the remainder will be set at a greater distance. The relationship between the coast and the Hafit tomb distribution of the Batinah is also unique. The Batinah band runs almost parallel to the coast, but never touches it. In other regions the relationship between the tombs and the sea is much less ambiguous — in the very east of Oman Hafit tombs are found in considerable concentrations on the coastline, while the tombs of the interior are a very great distance from it. It is unclear what this indicates — whether it is an incidental result of the very unusual size of the Batinah coastal plain, or that the Hafit population had a unique relationship with the sea. Many of the Hafit tomb grid squares of the Batinah are a greater than average distance from Umm an-Nar sites, but the general pronounced lack of archaeological research in the region means that this is unlikely to indicate anything significant about the nature of the Early Bronze Age Batinah society.

The analysis of the relationship between Hafit tomb numbers/ubiquity in the survey squares and other environmental and anthropogenic variables has revealed a great deal about the broader distribution of the funerary structures in the landscape of the northern Oman Peninsula. Discussion of tomb distribution has also helped to define the variables that constrained and shaped Hafit society, as well as highlighting other characteristics peculiar to the Batinah.

4.6 Discussion

Having mapped the distribution of Hafit tombs across the northern Oman Peninsula, estimated their number and the size of the living Hafit population, and utilised GIS to analyse the relationship between the numbers/ubiquity of the tombs and the natural and anthropogenic environment, this section will integrate these results and discuss what they may reveal about the nature of Hafit society. This subject will be explored thematically, examining what this research suggests regarding Hafit social organisation, subsistence, technology, trade and exchange, and ideology and belief.

The results of the NOP-GE survey provide much potential insight into the social organisation of Hafit society. The Hafit tomb distribution presented by the grid squares shows an agglomeration of the tombs with areas of density and areas of void. The tomb agglomerations show a greater density in the centre, with a lower concentration of tombs in the surrounding grid squares. In some cases these clusters are surrounded by areas completely devoid of tombs, and in others they merge with the areas of low concentration of adjacent clusters. These agglomerations could represent individual Hafit territories — each delineating the range of a single population and social entity. In many cases, the boundaries of these possible Hafit territories overlap geographically with the basins of wadi systems. This is clearest on the southwestern side of the Hajar Mountain range — the basins of the large inland wadis with high, mountain watersheds quite clearly form their own tomb agglomerations (Figure 4.50). This social division of the landscape is unsurprisingly given the aridity of the region — even with slightly higher precipitation in the Hafit period (Parker and Goudie 2008: 468) — with access to water resources playing a major role in shaping the social structure of the Hafit population. With twenty or so sizeable territories spread across the region, the population of each must have been relatively small — between 500 and 3,000 people, based on the total population estimate and the variation in the size of the agglomerations. This is a tiny population given the size of each territory. Most range from hundreds to low thousands of square kilometres — a low population density. In terms of the social organisation of the Hafit population, the NOP-GE survey results might suggest that the region was divided into large but quite sparsely occupied territories defined by hydrological basins and centring on the major wadi channels. The Batinah is the major exception to this general observation, and will be discussed in greater detail later in the chapter.

Analysis of the NOP-GE survey results has the potential to shed considerable light on Hafit subsistence strategies. Many of the variables analysed indicate a strong Hafit preference for a certain part of the northern Oman Peninsula landscape — the foothills on both sides of the Hajar Mountains. In terms of access to water and plant resources, the foothills are a salient part of the landscape to occupy — in this zone the wadis have collected large volumes of water from the mountain uplands and higher foothills, but the surface flow has yet to sink into the alluvial plain. This provides both the human and plant population with a ready water supply. The foothills are also a good area from which to take advantage of seasonal resources when rain falls in the winter — in particular the water pools and annual vegetation in more elevated areas — while still allowing access to the groundwater, contained within the gravels, and the deep-rooted vegetation of the lower plains if surface flows dwindle completely in the summer months. This preference for the low foothills may suggest that the Hafit population followed some form of nomadic pastoralist strategy, moving their animals throughout their wadi basin territory depending on where water supplies and adequate grazing was available. This is certainly consistent with the tomb distribution patterns which follow major wadi channels and stretch from the lower mountain areas to the upper plains, but with the tombs most densely concentrated in the lower foothill zone. If sedentary farming were the primary means of subsistence one would expect to see either much smaller territorial areas, or a relatively uniform distribution with perhaps a small number of regional centres. The distribution of the Hafit tombs would also match modern

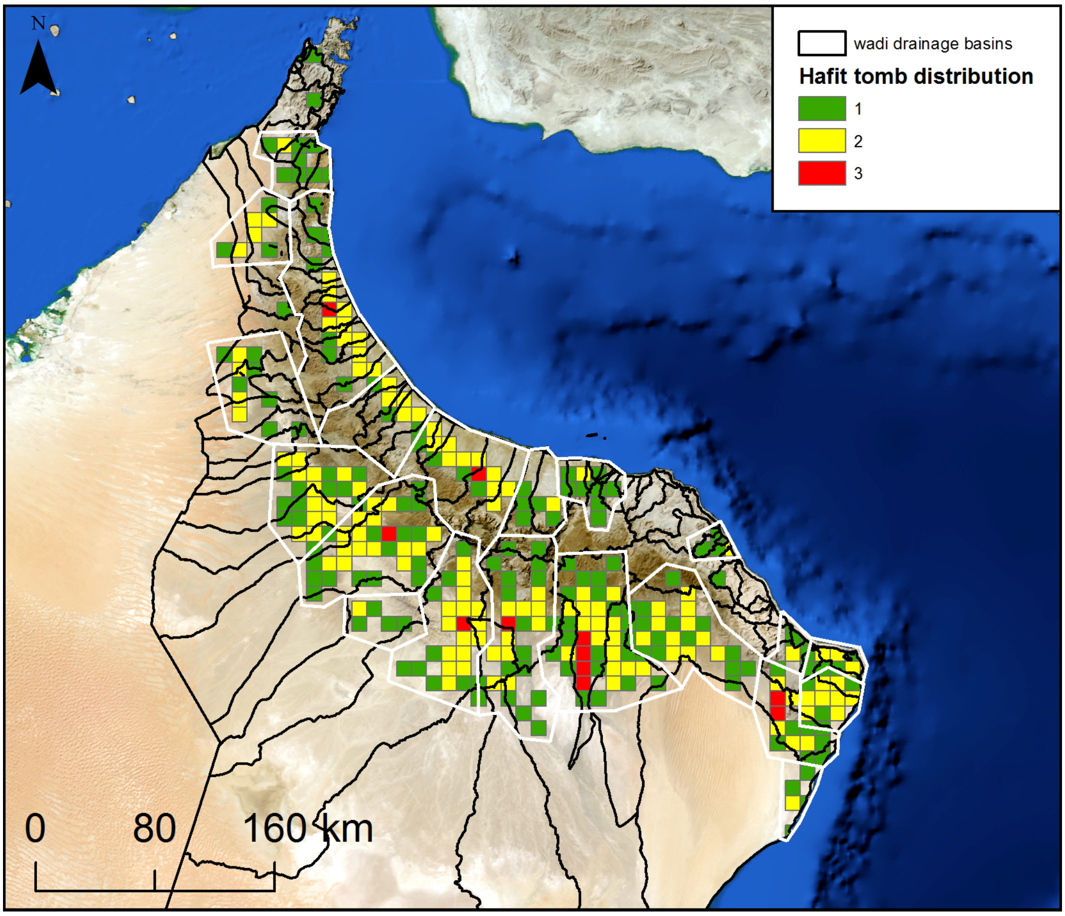


Figure 4.50: Map of the agglomerated tomb distribution, wadi basin boundaries and possible Hafit territories

settlement patterns, which show a preference for either elevated areas where water flow is more concentrated and may be more easily controlled for irrigation purposes or flat coastal plains with rich supplies of groundwater. Alternatively, a much tighter spatial relationship with the Umm an-Nar sites might be expected, demonstrating continuity in site occupation rather than some overlap in the general areas that were occupied. The survey results suggest that the importance of the coast in Hafit subsistence varied considerably across the region. In the large wadi basin territories of the interior, it seems unlikely that the coast played a significant role in feeding the population. However, in Ja'alan, the only area where the lower foothills of the Hajar Mountains meet the sea, the distribution of Hafit tombs along the coast suggests that it may have represented a critical resource, although as the tomb distribution follows the major wadis from the coast inland towards the mountains it is unlikely that the sea provided everything necessary to sustain the Hafit population. The distribution of the tombs of the Batinah — running parallel to, but at some distance from, the coast — makes it difficult to assess the importance of the sea and other coastal resources as food sources. However, there seem to have been some substantial differences in subsistence strategies between the various regions of the northern Oman Peninsula.

Although circumstantial, the survey's population estimate can be used to postulate on the subject of possible subsistence strategies. Wilkinson's figures suggest that the population of the northern Oman Peninsula during the twentieth century — prior to modernisation — was between 500,000 and 600,000[14], with population density between 2.2 and 2.5 people/sq-km (1977: table 1). It should be noted that these figures were calculated for a period of significant economic prosperity in eastern Arabia (Hopper 2015: 6–7), a 'boom' period that is unlikely to be an entirely fair characterisation of agricultural societies throughout the Islamic period, but unfortunately they are the only such figures available. The study area's Hafit population was estimated to be between 11,000 and 29,000 — a population density of 0.14–0.35 people/sq-km, or still only 0.35–0.92 people/sq-km if '0' grid squares are excluded. The fact that Hafit tombs are found across such large parts of the study area, but with such a slight population density suggests that different subsistence strategies were operational during the two periods. Although fluctuating substantially according to the local climate and conditions, different modes of subsistence are able to support differing population densities — one genetic study provides some anthropological examples of population density in hunter-gathering societies (0.03–0.6 people/sq-km); pastoral nomad populations (0.06–2 people/sq-km); incipient/primitive agricultural groups (4–20 people/sq-km); and fully developed agricultural societies (up to 400 people/sq-km) (Cavalli-Sforza and Bodmer 1999: 431–432). These examples suggest that the estimated Hafit population density is most consistent — in a relatively challenging, semi-arid environment — with nomadic pastoralist societies. According to these figures, if agriculture played a major role in Hafit subsistence, one would expect a much larger Hafit population.

The regional distribution of tombs also has the potential to reveal information about Hafit technology. Other than the hydrological variables, the spatial relationship between Hafit tombs and copper ore sources is the strongest of any analysed. Although it is possible that this could either be a complete coincidence or a geological 'happy accident' — that terrain favoured for other reasons happened to be proximate to useful mineral resources — the strength of the relationship makes these possibilities unlikely. Rather it appears that the distribution of copper ore seems to have played a significant role in dictating the Hafit occupation of the landscape. In turn, this suggests that copper was of major domestic importance economically and technologically rather than an incidental,

[14] roughly equivalent to the study area, although strictly some of the emirates (Dubai and Abu Dhabi) should be removed from the calculations within his table

opportunistically exploited resource. Later in the period, a desire to protect and exploit certain rich ore sources may have proved a major factor leading to the adoption of a sedentary lifestyle.

The results of the survey may also shed light on the nature of trade and exchange during the Hafit period. The tomb distribution suggests that the low-density peripheries of territories were frequently adjacent, offering natural points of contact between local Hafit populations. These occur at the watersheds of the wadi basin territories and suggest that it was here, with contact occurring naturally as the populations ranged throughout their land, that local exchange may have taken place. It is not unlikely that if Hafit migration was seasonally determined, then the places and times of contact between groups would have been fairly predictable and regular. As the estimated size of the Hafit population was small, and as tomb distribution patterns suggest that it was nomadic, this may explain how the homogenous Hafit material culture was spread across such a large area. The strong spatial relationship between the distribution of copper ore and Hafit tombs suggests that the metal played an important part in local and international trade and exchange. Mesopotamia is known to have used copper that is chemically consistent with Omani ores from the 4th millennium BC, and therefore presumably was a major trading partner of the Hafit population (cf. Begemann et al. 2010). If this was the case, the lack of significant concentrations of Hafit tombs in the coastal areas closest to the Arabian Gulf is interesting, considering the major areas of coastal occupation in Ja'alan — the area furthest from Mesopotamia — and the Hafit tomb 'band' near to the Batinah coast. This may suggest that the Hafit population were not proactive or highly organised in regional trade, but rather allowed powerful trading partners to come to the major areas of copper production themselves.

Although perhaps only indirectly, the results of the survey may be able to uncover certain aspects of Hafit ideology and belief systems. The similar pattern seen generally in tomb distribution suggests that the regional Hafit population as a whole shared — at least to some extent — a belief system regarding the disposal of the dead, and the role that they played in declaring ownership of territory. With large numbers of Hafit tombs delimiting the boundaries and footprint of territorial ranges, the natural interpretation is of an egalitarian society in which — at least when deceased — each member was of equal significance. As with the exchange of material culture, the fact that the Hafit population appears to have been small and mobile suggests that ideas and beliefs could be quickly and easily transmitted throughout the region, while the frequent adjacency of the territorial edges may suggest that there was sufficient contact between the population to facilitate this.

It is not only the presence of Hafit tombs in the data that may uncover the nature of Hafit society, but also their very low numbers or absence in certain areas[15]. The major areas are: the interior plains; the Batinah plain; the uplands of the eastern, central and northern Hajar Mountain ranges; the Musandam Peninsula; the Muscat area; and the northern and eastern U.A.E. (Figure 4.51). For the most part this is consistent with the analysis hitherto — water is much harder to source in the mountain uplands — where it quickly runs off — and on the sedimentary plains — where it sinks into the gravels — and therefore Hafit tombs make only limited, low density incursions into these areas. This explains the absence or very low density of the funerary structures in all but two of the areas.

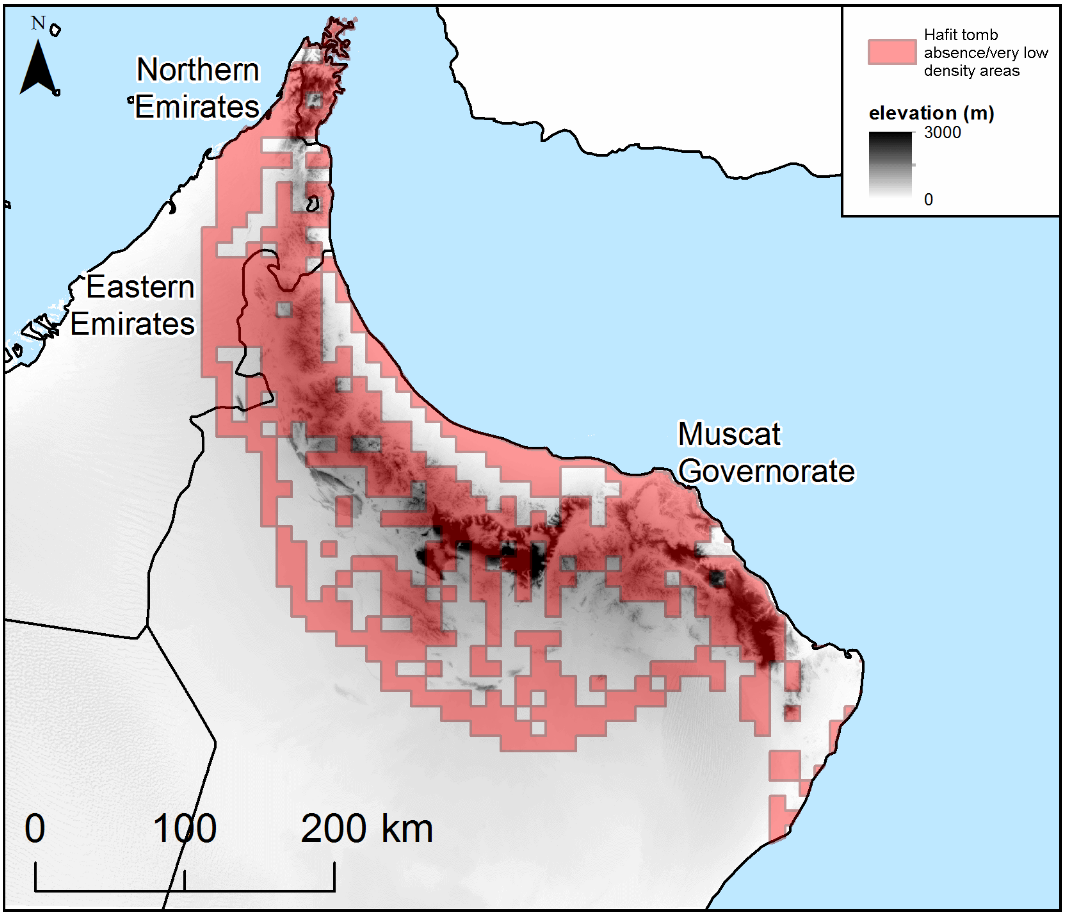


Figure 4.51: Map of Hafit tomb absence/very low density areas — unrelated to elevation

There is a significant gap in the distribution at the eastern end of the Batinah, in and around the Muscat Governorate, but this may easily be explained by the rapid urbanisation that has affected this part of the study area over the last few decades. More difficult to explain is the lack of Hafit tombs in the northern and eastern parts of the U.A.E., on both

[15]the extent to which tombs can define the areas of occupation inhabited by the living is a much larger question that will be discussed later in the thesis

sides of the northern Hajar Mountain range. This is particularly confusing in light of the archaeology of the later Bronze Age, which is particularly plentiful in this area (cf. Velde 2003). It seems unlikely that the reason for this dearth in Hafit tomb distribution is related to hydrology, although not as large as some of the substantial wadis of Oman, water courses can still be found in this area, and indeed it is known to receives a greater amount of precipitation than the more southerly areas (Figure 4.52). What may explain the absence or very low number of Hafit tombs in this area are the lack of exploitable copper ore sources. Although copper mineralizations have been reported in the northern and eastern emirates, they are much poorer sources of ore — being found within the Hawasina series rather than the ophiolite — and there is no archaeological evidence for the exploitation of this type of copper mineralization in southeastern Arabia from any period (Weeks 2003: 14). If this proves to be the reason for the lack of Hafit tombs in this part of the Peninsula, than it strongly emphasises the importance of copper in Hafit society.

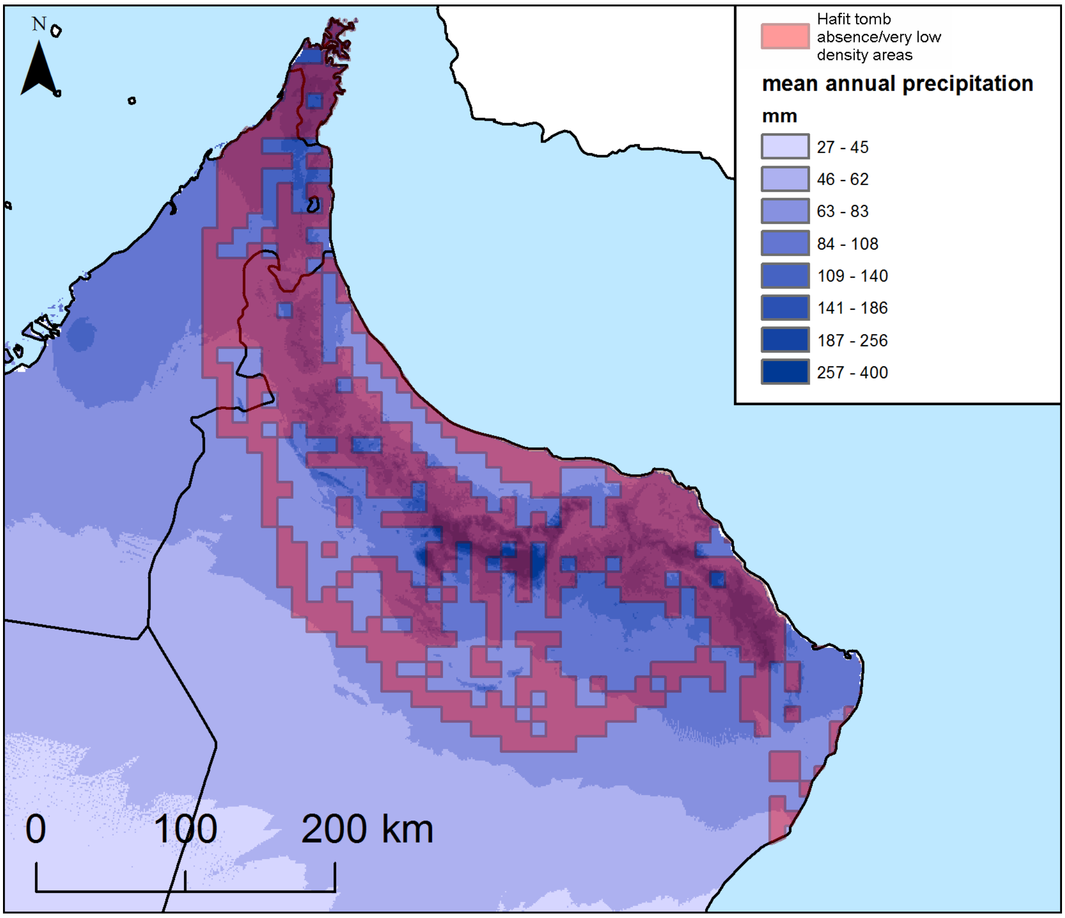


Figure 4.52: Map of Hafit tomb absence/very low density areas — unrelated to annual average precipitation, WorldClim data (Hijmans et al. 2005)

The distribution of Hafit tombs in the Batinah differs markedly from that of the northern Oman Peninsula generally. What this may indicate regarding Batinah Hafit society will be explored in much greater detail — with much more evidence available — in later chapters. Suffice to say that the 'wadi basin territory' model is untenable for this region: Hafit tombs show a much weaker relationship to the surface hydrology. In contrast, clearly the Batinah's very rich copper ore resources were of particular importance to the region's Hafit population. Batinah Hafit society's relationship with the coast is much more difficult to surmise. The striking contrast between modern settlement patterns and the Batinah's Hafit tomb distribution suggests that the socio-economic strategies of the two societies — the Batinah boasts the majority of Oman's arable farmland (Zekri 2008: 243) — were markedly different. The differences in the distribution of the Batinah Hafit tombs and those in other regions of the northern Oman Peninsula may hint at differences in how the population exploited the landscape.

This section has amalgamated the results of the chapter as a whole and explored what collectively the tomb distribution may reveal about the nature of Hafit society across the northern Oman Peninsula. In terms of the social organisation of the Hafit population, the agglomerated tomb distribution suggests that the landscape was divided into sizeable territories, possibly delineated by wadi system watersheds. With 20 or so medium to large territories, the Hafit population occupying each at any one time may have numbered between 500 and 3000 — a small number given their area. With regards to Hafit subsistence strategies, the tomb distribution patterns suggest that each territory was occupied by a small number of nomadic pastoralists, that focused their occupation of the landscape on the lower foothills at the base of the Hajar Mountains, from which they were able to take advantage of seasonally available resources in the mountains — and for some also at the coast — by moving along the path of the wadi channels where grazing and water were always available. Varying spatial relationships to the coast suggest that the importance and exploitation of marine resources differed markedly between local Hafit populations. The strong relationship between the distribution of Hafit tombs and copper ore sources suggests that the metal was of major domestic importance economically and technologically. With regards to trade and exchange, the results of the survey suggest that exchange between local groups could well have taken place at the peripheries of the wadi basin territories, while international trade with Mesopotamia and other powers is much more likely to have been concentrated in specific regions where the metal was exploited. A small and mobile population may well have facilitated the spread of ideas and beliefs through the region, with a shared egalitarian-based use of the dead to mark resources suggesting a similarity in ideology. The lack of Hafit tombs in certain areas that do not fit with the general pattern of preferred occupation appears to emphasise the significance of copper in Hafit society.

Although the NOP-GE survey results may reveal a great deal about the social, economic and political organisation of Hafit society, a note of caution must be expressed. The data is based on remote sensing that has not been ground-truthed, and although a high level of magnification was used in examining the tombs, and every effort was made to distinguish Hafit tombs from other Later Prehistoric Tombs, it would be naive to argue that the NOP-GE results represent the relative distribution of Hafit tombs with total accuracy (Chapter 4.2). Moreover, the sampling-based approach of the NOP-GE survey means that Hafit tombs can be missed (Chapter 4.3.3). However, although there will be some innaccuracies in the data, the Google Earth-based methodology has nevertheless provided the most complete picture of Hafit tomb distributions available anywhere in the published literature, and represents an excellent starting point to analyse and discuss the relative density of Hafit tombs across the northern Oman Peninsula.

4.7 Conclusion

The aim of this chapter was to carry out a low resolution remote sensing survey of Hafit tombs to provide insight into the nature of Hafit society across the northern Oman Peninsula. This is worthwhile both for its own sake and to generate a consistent dataset with which to compare to analysis of the Hafit archaeology of the Batinah in later chapters. The chapter had three objectives: to survey the density and ubiquity of Hafit tombs across the northern Oman Pensinula; to calculate an estimate of the total number of Hafit tombs and the size of the population that constructed them; and to use GIS analysis to model the regional distribution of Hafit tombs within their natural and anthropogenic environment.

Google Earth was used to qualitatively assess the distribution of Hafit tombs within 10km grid squares covering a 81,000 sq-km area of the northern Oman Peninsula, encompassing northern Oman and the northern and eastern U.A.E. Each grid square was examined for five minutes and was awarded an ordinal score of between ‘0’ and ‘3’ depending on the density and ubiquity of the tombs. The proportion of the 873 grid squares at each level were as expected — with ‘3’ squares being the least numerous and ‘0’ squares the most. The grid squares shows agglomeration into areas of tomb presence and tomb void, with the high density squares surrounded by others with fewer tombs. The level of detail of the distribution of Hafit tombs that the results of the NOP-GE survey provides is far superior to — but also in agreement with — the most complete published map of Hafit tomb sites, and a plot showing the location of all such known sites in the literature. However, while every effort was made to distinguish Hafit tombs from similar Later Prehistoric Tombs during the survey it would be naive to argue that the NOP-GE results are totally without error.

In order to quantify the ordinal survey scores that were assigned to each grid square, six squares of each level were randomly selected and then remotely surveyed for individual Hafit tombs in Google Earth. The density and ubiquity of the Hafit tombs within the grid squares was analysed, and the total number of tombs within the survey area was extrapolated, calculating a corrected estimate of 27,040 Hafit tombs. Allowing for Hafit tombs that are not visible in Google Earth, measured in the previous chapter, this figure rises to 53,236 surviving tombs. Ubelaker's formula was used to estimate the average size of the living Hafit population during the period. An estimate of between 11,344 and 28,588 people was calculated, although this is intended only as a semi-speculative guide rather than an accurate population estimate.

The results of the survey were then analysed with GIS to model the distribution of Hafit tombs with regards to their natural and anthropogenic environment. A total of twelve variables were analysed relating to elevation and topography, hydrology, modern settlement, natural resources, and Early Bronze Age archaeology. The analysis revealed that the Hafit population preferred a specific terrain: the low foothills on either side of the Hajar Mountains; tombs only lightly penetrated into more mountainous areas and the plains. A strong relationship between Hafit tomb distribution and hydrology was discovered — grid squares with high tomb numbers/ubiquity were generally located in areas only a short distance from a significant water course, and usually within 500m of a channel draining a very substantial area. Hafit tombs showed a preference for areas that were at a low-medium distance from a modern settlement, but were only very rarely found in areas where modern settlements were densely distributed. The relationship between Hafit tombs and the coast was mixed, in some areas coastal areas boasted a high number of tombs, but in the vast majority of cases tombs were found at a substantial distance from the sea. In contrast, an extremely strong spatial relationship was revealed between Hafit tombs and copper ore sources. With regards to later Early Bronze Age archaeology, Hafit tombs were frequently found within a reasonably close proximity to Umm an-Nar sites, but not to such an extent to suggest close continuity in settlement and economy between the two periods. Hafit tomb distribution in the Batinah follows a different pattern to that of the others regions, in particular demonstrating a much weaker relationship with wadis and an even stronger link to copper ore sources.

The analysis of the NOP-GE survey results sheds considerable light on the nature of Hafit society across the northern Oman Peninsula. The distribution of the Hafit tombs suggests that the study area was made up of a number of sizeable territories delineated by wadi drainage basins, each occupied by a relatively small population. Patterns within the data suggest that the region was largely occupied by nomadic pastoralists that in particular favoured the lower foothills at the base of the Hajar Mountains, from where they were able to exploit resources in other areas. The strong spatial correlation with copper ore sources suggests that the metal was of major domestic importance. The distribution of the tombs hint that exchange between local groups could well have taken place at the peripheries of the wadi basin territories, while international trade with Mesopotamia and other powers is much more likely to have been concentrated in specific regions where copper was exploited. The distribution of the funerary structures suggests a common egalitarian-based use of the dead to mark territory, part of an ideology or belief system that could quickly spread through a small and mobile population. The areas in which Hafit tombs are absent in a manner that is inconsistent with the general patterns of distribution seen may relate to the uneven distribution of quality copper ore sources. The differences between Hafit tomb distribution in the Batinah and in the northern Oman Peninsula more generally may hint at a unique characteristic or strategy of Hafit society in this part of the region.

This research has achieved a great deal within the wider framework of the study of the Hafit period. The data collection encompasses by far the largest area of any survey of Hafit tombs, over 80,000 sq-km covering the entirety of the area in which the vast majority of Hafit tombs have been reported. When mapped, the results of the survey represent the first ever attempt to produce an accurate representation of the extent and variation of the distribution of Hafit tombs across the northern Oman Peninsula. Similarly, the estimate of the number of surviving structures is only the second to have been suggested, and the first using a scientifically reproducible methodology. Likewise, the estimate of the living Hafit population occupying the region during the period is the first to be calculated. The GIS analysis of the distribution of the Hafit tombs is also entirely original for this period and region. Together the results of each section of the chapter have led to considerable illumination of the nature of Hafit society in the northern Oman Peninsula.

While achieving a great deal, this research underlines the face that a considerable amount still remains to be done. In terms of the GIS analysis, other areas could be considered — for example geology and soils — and also other variables or datasets could be used to examine matters already considered more closely — for example looking at the depth of ground water as well as the surface hydrology. The estimates of the number of Hafit tombs and the living population could be further refined by undertaking more detailed survey of the grid squares. The ideas that have been tentatively suggested about the nature of Hafit society need further testing and consideration, especially through the use of ground-based fieldwork to test, verify and complement the NOP-GE survey results. Furthermore, while the study area defined during this research covers the vast majority of known Hafit tomb sites, it does not provide any information on the distribution of Hafit tombs on the central and western coasts of the UAE where their presence has been confirmed (Vogt, Gockel, et al. 1989), or along the central coast of Oman where 'cairn' tombs have also been reported (Biagi 1988). The data collected and analysed during this chapter should provide an excellent impetus for further research into Hafit tombs across the northern Oman Peninsula, providing a low-resolution map of tomb distribution that may be further refined and improved.

This chapter provides an excellent foundation for the rest of the thesis. By mapping and analysing the distribution of Hafit tombs across the whole of the northern Oman Peninsula it provides a consistent model with which to compare to more detailed research into the Early Bronze Age funerary archaeology of the Batinah. It also provides excellent insight into the nature of Hafit society generally, and will form an important part of the thesis' final discussion. Having established a general baseline for Hafit tomb distribution and society across the region as a whole, research specifically into the Batinah may now be undertaken and presented in the following chapters.

Chapter 5

Mapping and analysing the distribution of Hafit tombs in Al-Batinah

5.1 Introduction

The NOP-GE survey results presented in the previous chapter demonstrate that there are many more Hafit cemeteries in the northern Oman Peninsula than are known in the current literature. The extent of this knowledge gap varies between regions and is most marked in the Batinah. Data from an official Omani Ministry of Heritage & Culture sites map reveals that the lack of archaeological investigation in the Batinah is not only limited to the Early Bronze Age (Figure 5.1). If we are to understand the Hafit period in the region then a great deal of research remains to be done.

This chapter will explore the Batinah's Hafit tomb distribution to shed light on the nature of Hafit society in this neglected region. Google Earth will be used to locate every visible Hafit tomb in the Batinah, and their distribution will be analysed with GIS. This is a major undertaking as the Batinah covers a huge area of ~12,500 sq-km. Before attempting to survey the whole region, the methodology will be tested in six transects, allowing it to be refined. This transect survey will also provide an opportunity to explore the Later Prehistoric Tombs (LPTs) of the Batinah — including Cell Graves, Honeycomb Tombs and other less common types (Chapter 4.2.1) — which could confuse the Hafit tomb survey. The Batinah Google Earth (B-GE) survey will then be expanded across the region. The B-GE survey's final results will be analysed with GIS to model the distribution of the tombs in their natural and anthropogenic environment, providing insight into the Batinah's Hafit population. As well as generating a detailed map of the Hafit occupation of the Batinah landscape, the B-GE survey will also provide a means of testing the NOP-GE survey's findings.

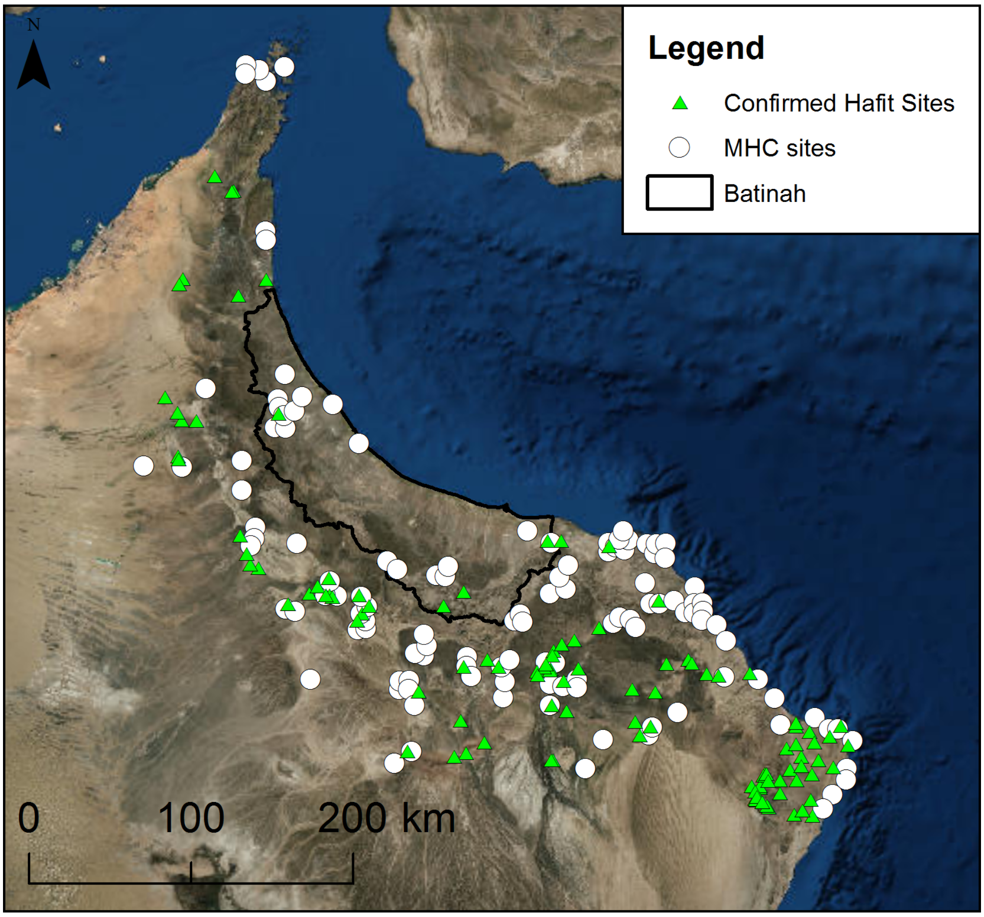


Figure 5.1: Map of known Hafit cemeteries from the literature (Appendix A.1) and Ministry of Heritage & Culture sites from all periods (National Survey Authority 2005)

The chapter is divided into three sections: the transect survey; the full Batinah survey; and the GIS analysis. Some of the GIS analyses described in this chapter were first described in a paper examining Hafit tomb distributions in western Ja'alan and Wadi 'Andam (Deadman and al-Jahwari 2016).

5.2 Transect survey

5.2.1 Method

Defining the number, extent and position of the transects was the first stage of the B-GE transect survey. The combination of six 10km-wide transects was chosen as an adequate compromise between surface area, spacing, regional coverage and research time. The transects run perpendicular to the line of the Batinah's mountains and coast, positioned to take advantage of the roads running inland from the Sultan Qaboos Highway (Figure 5.2, Table 5.1)[1].

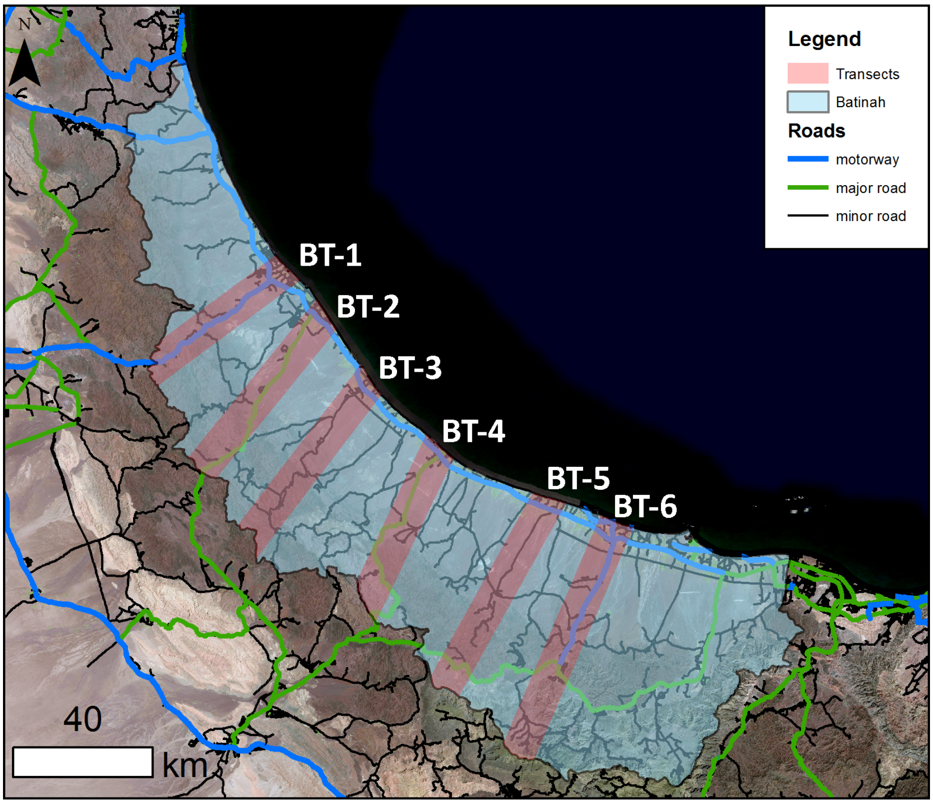


Figure 5.2: The Oman road network and the location of the six Batinah transects

Google Earth was used to locate suspected Hafit tombs, and ground-truthing fieldwork to assess the data's accuracy. Due to the Batinah's large surface area, a slightly lower level of magnification — i.e. imagery resolution — to that used in previous surveys (Chapters 3.3 & 4.4.1) was trialled, using a 1km grid rather than Google Earth's 12 arcsecond grid[2].

[1]The precise boundaries of the transects were generated by drawing 6 lines on Google Earth and **buffering** each to a distance of 5km in ArcGIS, and **clipping** the **polygons** to the Batinah's regional borders

[2]strictly this represents an increase in the width of the survey grid squares from ~370m to 1km, but because a larger computer screen was used during this survey, the magnification level was only slightly less than half that of earlier 12 arsecond surveys (Chapter 3.3 & 4.4.1)

Table 5.1: Location and size of Batinah transects

Transect	Start	Main Road	Length (km)	Area (sq-km)
BT-1	Falaj al-Qabail	Route 7	49.3	477.6
BT-2	Sohar	Route 8	57.7	571.3
BT-3	Saham	Falaj al-Harth	54.2	565.7
BT-4	Al-Khaburah	Route 9	50.3	499.6
BT-5	Al-Suwayq	Wadi al-Haimli	62.1	623.5
BT-6	Al-Mussanah	Route 11	72.7	724.4

The 1km survey grid was created in ArcGIS and imported into Google Earth[3]. Google Earth's **Historical Imagery Tool** was used to ensure that the clearest and highest resolution satellite imagery was used throughout the survey. Each column of the grid was examined, moving from north to south; suspected Hafit tombs were marked with **placemarks**, and suspected LPT cemeteries were delineated with **polygons**.

The survey's findings were then evaluated through ground-truthing fieldwork. Three accuracy aspects were assessed: had suspected Hafit tombs been correctly identified; had LPT cemeteries been correctly identified; and had any Hafit cemeteries been missed?

The three densest suspected Hafit cemeteries in each transect were examined in the field, and two typical Hafit tombs were recorded at each site. Tomb recording consisted of: GPS coordinates; photographs; basic dimensions; a rough sketch; and a site sketch map. If LPTs were also present, then two typical examples were also recorded. A 'possible' option was sometimes used in classifying tombs when there was some ambiguity in their form (e.g. Hafit, Hafit?, Cell Grave, Cell Grave? etc). Visual confirmation of a transect's other suspected Hafit cemeteries was sought as they were passed during fieldwork — field glasses and a camera were used.

Up to three suspected LPT cemeteries were also examined in each transect. Two typical tombs were recorded at each site. If Hafit tombs were also present, then two examples were also recorded.

'Negative' ground-truthing was also carried out, testing whether any Hafit cemeteries had been missed during the B-GE transect survey. A route was driven through each transect to cover as much ground as economically as possible. Missed Hafit cemeteries were recorded with a GPS waypoint, a brief description, and photographs.

5.2.2 Results

In total, 2,786 suspected Hafit tombs and 15 possible LPT cemeteries were located during the B-GE transect survey (Figures 5.3, 5.4).

[3] a 1km fishnet was created using the **Create Fishnet Tool**, **clipped** to the transect boundaries and exported into Google Earth using the **Layer to KML Tool**

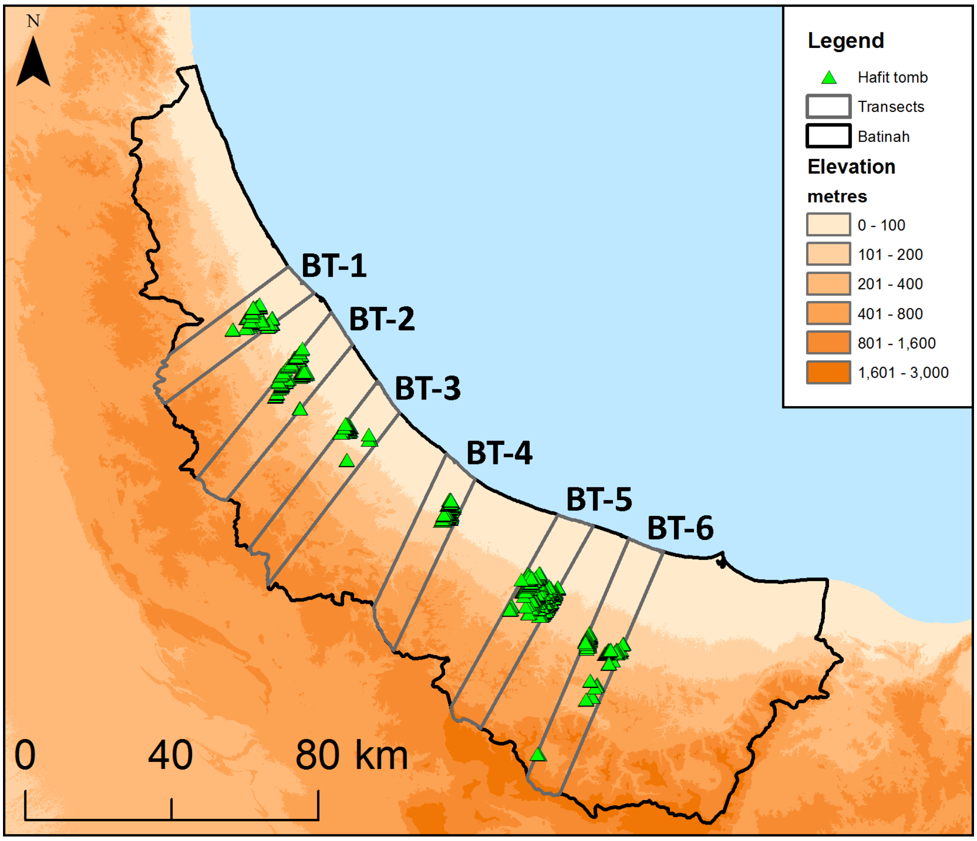


Figure 5.3: Suspected Hafit tombs located during the transect survey

The number of suspected Hafit tombs varies between transects (Figure 5.5). Five contain between 258 and 461 possible Hafit tombs, while 1,086 were located in BT-5 — ~40% of the total. Tomb distribution is not uniform across the length of the transects — the vast majority are concentrated between the Hajar Mountain foothills and the coastal plain. The number of possible LPT cemeteries was uneven: 12 of the 15 were found in BT-1; 2 were observed in BT-6; and 1 was located in BT-3.

Ground-truthing fieldwork was carried out over five days (Table 5.2). Tombs were recorded at 18 suspected Hafit and six possible LPT cemeteries: each was given an identity number prefixed with 'HC-' for Hafit and 'PH-' for LPT sites (Figure 5.6). The results, summarised below, are presented in greater detail elsewhere (Appendix B.1).

BT-1: Wadi Jizzi

BT-1 contains a significant number of suspected Hafits tombs and LPTs. Negative ground-truthing of the area was carried out using Route 7 that runs through the transect, allowing its entire length to be investigated (Figure 5.7). No Hafit cemeteries were observed that had not been located on Google Earth.

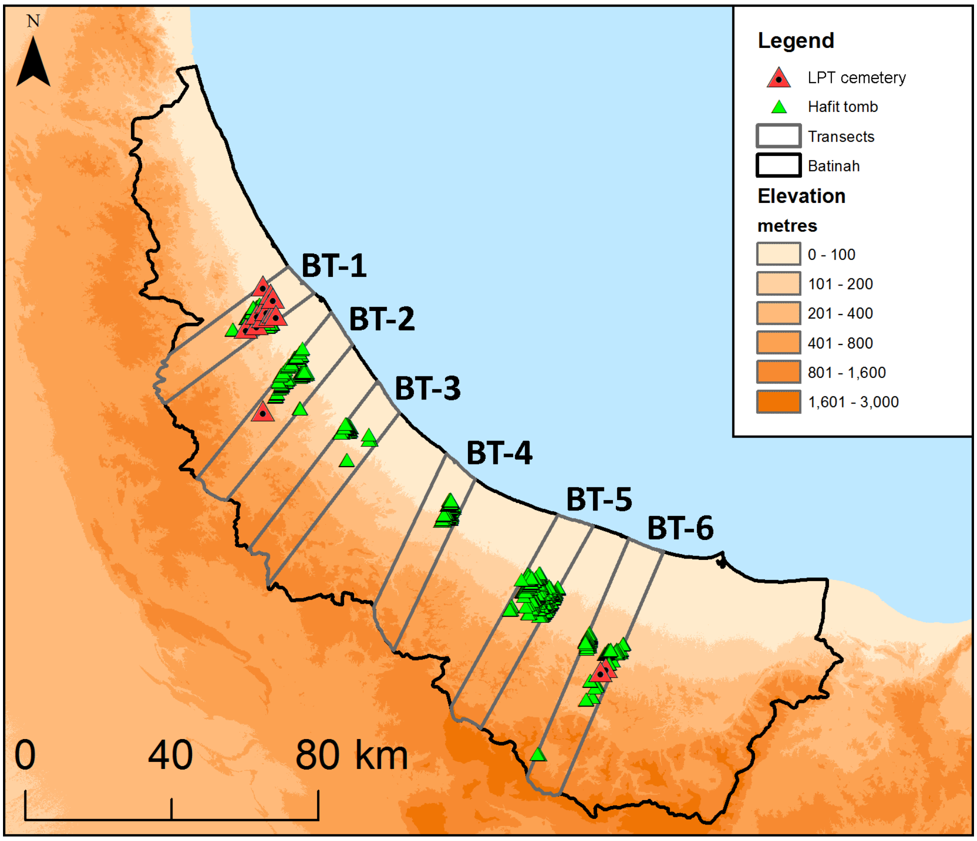


Figure 5.4: Possible Later Prehistoric Tomb cemeteries located during the transect survey

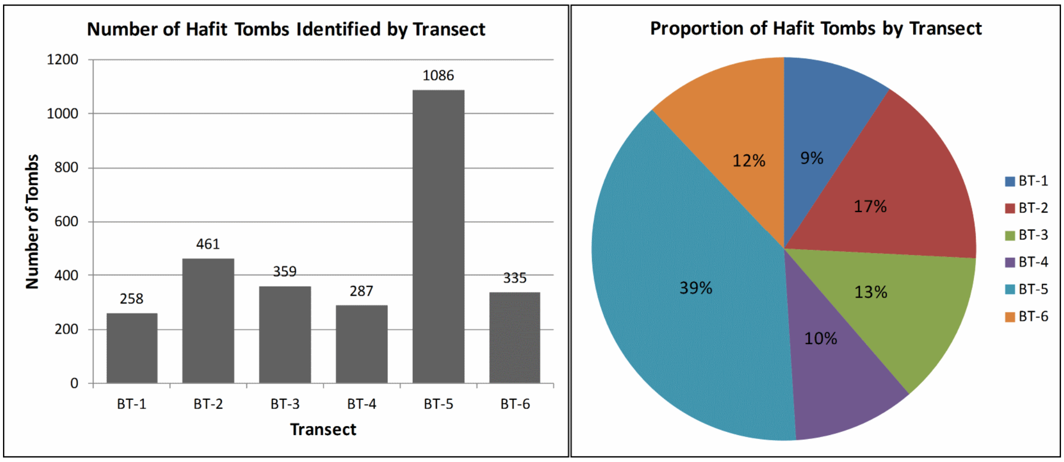


Figure 5.5: The number and proportion of suspected Hafit tombs in each transect

Three possible Hafit and three suspected LPT cemeteries were examined. HC-02 is a large cemetery of over 50 quite well preserved Hafit tombs built of wadi cobbles; two typical examples were recorded. HC-04 is a cemetery of more than 20 wadi cobble Hafit tombs and a single LPT. Two representative Hafit tombs were recorded as well as the very well preserved Cell Grave — it has 3 or 4 chambers and stands to over a metre in height (Figure 5.8). HC-07 encompasses hundreds of well preserved wadi cobble Hafit

Table 5.2: *Sites visited during transect survey ground-truthing fieldwork*

Transect	Date	Hafit	LPT	Site List
BT-1	28/02/2014	3	3	HC-02, HC-04, HC-07, PH-01, PH-06 & PH-09
BT-2	01/03/2014	3	1	HC-12, HC-13, HC-14 & PH-13
BT-3	05/03/2014	3		HC-17, HC-18 & HC-19
BT-4	05/03/2014	3		HC-20A, B & C
BT-5	10/03/2014	3		HC-22, HC-24 & HC-25
BT-6	25/02/2014	3	2	HC-35, HC-36, HC-38, PH-16 & PH-17

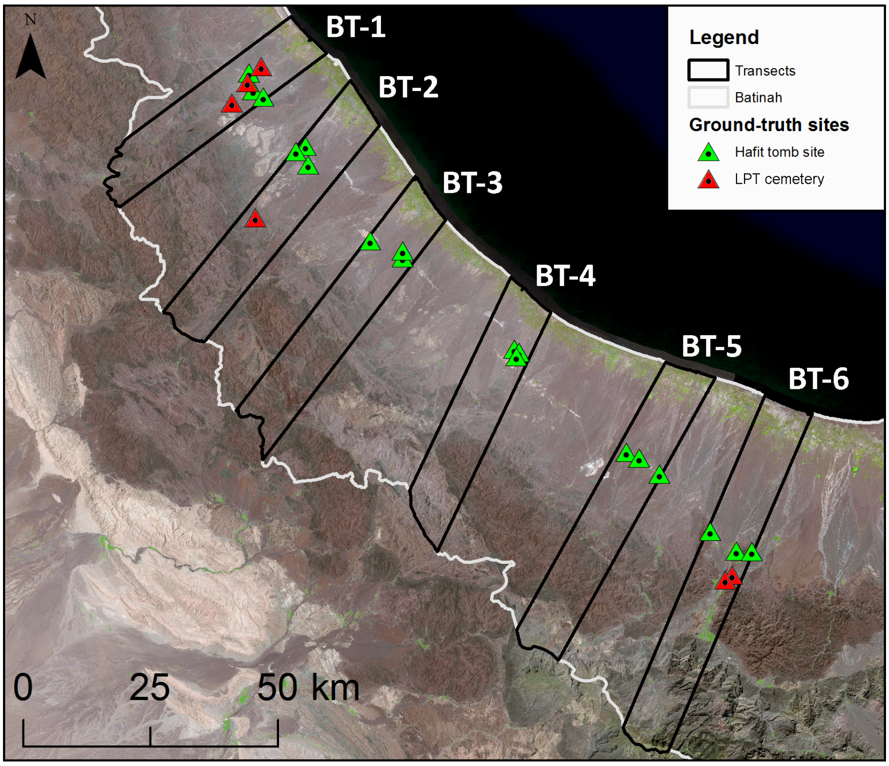


Figure 5.6: Suspected Hafit and LPT cemeteries where tombs were recorded during transect survey ground-truthing

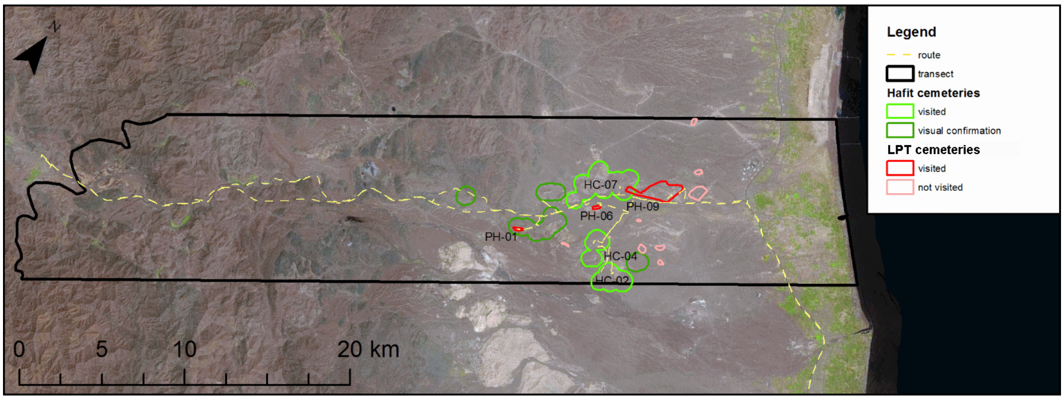


Figure 5.7: Ground-truthing fieldwork carried out at BT-1

tombs spread across a range of limestone hills; two were recorded, and suspected Samad/Sasanian/early Islamic green-glazed pottery was found in close proximity to the second. PH-01 — tentatively identified as a possible LPT cemetery during the B-GE transect survey — proved to be the remains of a Late Islamic village, with small house foundations resembling LPTs on the satellite imagery; the site was littered with typical red and cream Late Islamic wares, sea shells, and some copper finds. PH-06 consists of a diverse cemetery of LPTs running along a rocky ridge. Two structures were recorded: a single-chambered, horse-shoe shaped Cell Grave and a low, oval Honeycomb Tomb with five possible semi-subterranean chambers. PH-09 is a cemetery containing hundreds of Cell Graves spread across a range of hills; the structures shared a similar form, with a double wadi cobble wall with a gravel fill forming an oval, but some were single-chambered while others were conjoined in groups (Figure 5.9). Two representative examples were recorded.

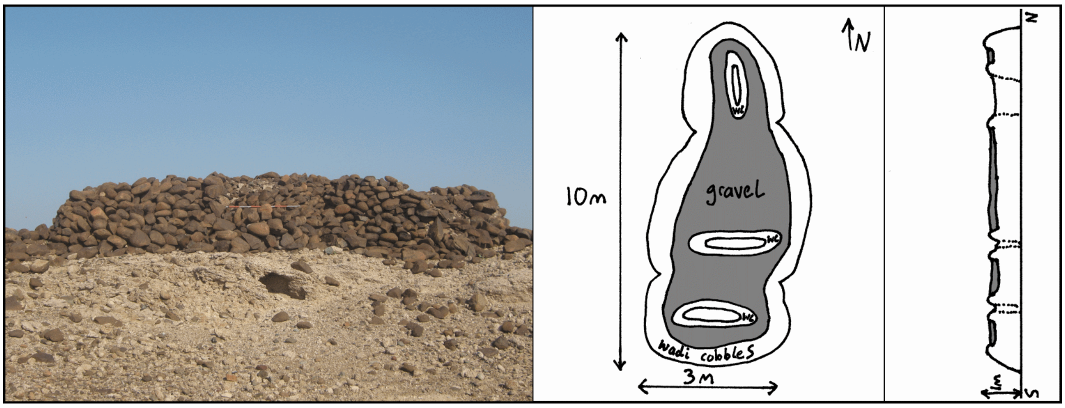


Figure 5.8: HC-04-1 — a multiple-chambered Cell Grave in a Hafit cemetery

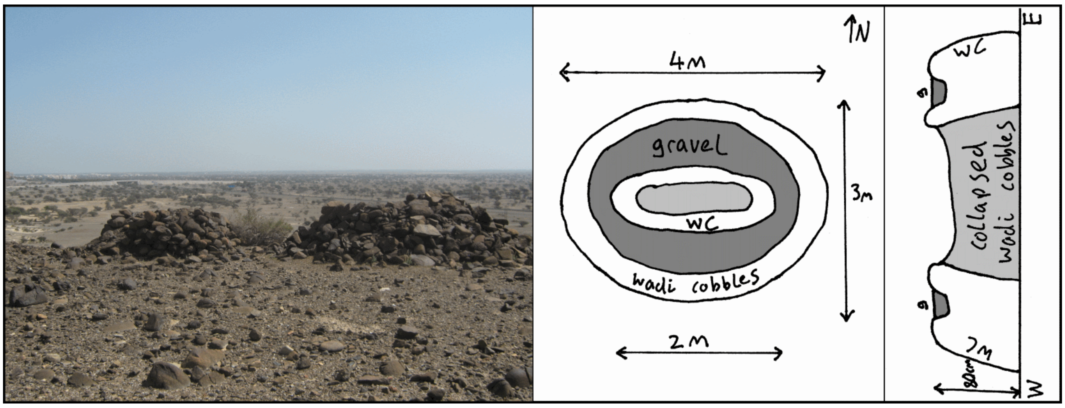


Figure 5.9: PH-09-1 (left) — a typical single Cell Grave

An attempt was also made to confirm visually the presence of tombs at other suspected Hafit cemeteries that were passed while travelling through the transect. Tombs were clearly apparent at a distance from the other four possible Hafit cemeteries (HC-1, HC-3, HC-5, HC-6). While undertaking fieldwork a possible Hafit campsite and an Umm an-Nar cemetery were discovered and briefly recorded (Appendix B.3).

BT-2: Sohar

Eight possible Hafit and a single suspected LPT cemetery were located on Google Earth in BT-2. Route 8 was used as the main route to negatively ground-truth the transect (Figure 5.10). Although the full length of the road was investigated, some parts of the transect could not be explored due to difficult terrain and a lack of suitable roads. A lone Hafit tomb apparently not located on Google Earth was later found to fall 100m outside of the transect, otherwise no unmapped Hafit cemeteries were observed.

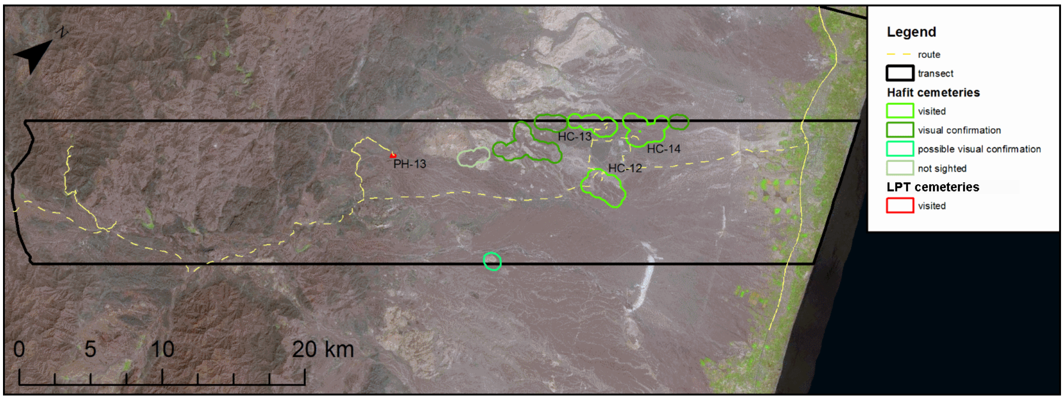


Figure 5.10: Ground-truthing fieldwork carried out at BT-2

Three of the eight possible Hafit and the single suspected LPT cemetery were examined in the field. HC-12 consisted of single-chambered Cell Graves rather than Hafit tombs; two typical examples were recorded. HC-13 contains hundreds of well-preserved Hafit tombs stretching across a range of hills; two were recorded (Figure 5.11). HC-14 consists of Hafit tombs and single and multi-chambered Cell Graves — stones from the earlier tombs had been used to build the LPTs. Four tombs were recorded: two badly disturbed Hafit tombs; a single-chambered Cell Grave; and a Cell Grave with three, linearly-arranged chambers. PH-13 is a considerable distance south of the other cemeteries, and consists of over twenty single-chambered Cell Graves arranged in two lines overlooking major wadi channels. Two typical examples were recorded (Figure 5.12).

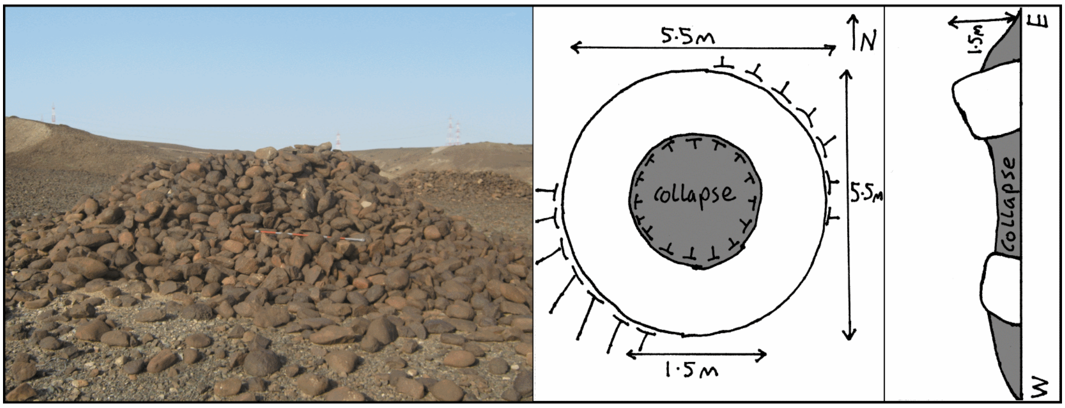


Figure 5.11: HC-13-1 — a quite well preserved Hafit tomb

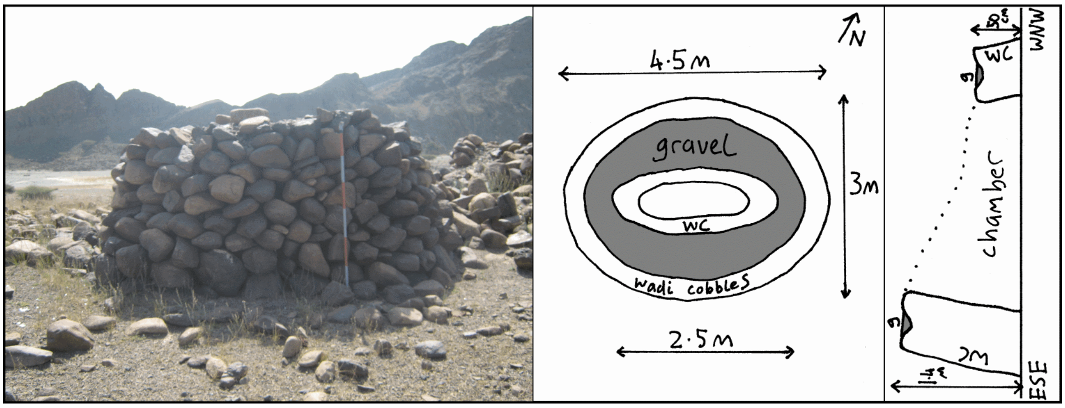


Figure 5.12: PH-13-2 — a well preserved, single-chambered Cell Grave

An attempt was made to confirm the presence of tombs at the transect's five other possible Hafit cemeteries. Tombs were clearly visible at three of these sites (HC-10, HC-11, HC-15), while possible visual confirmation was made at a third site that was considerably further away (HC-8). Views of the fifth possible Hafit cemetery were blocked by hills (HC-9).

BT-3: Saham

BT-3 yielded only four possible Hafit cemeteries. Negative ground-truthing of the area was carried out, making use of minor roads that pass through the southeastern part of the transect, but unfortunately the planned route into the mountains and ophiolite hills had to be abandoned after heavy rain made it too dangerous (Figure 5.13). No missed Hafit cemeteries were observed.

Tombs at two of the three suspected Hafit cemeteries were recorded. HC-17 is a small mixed cemetery of ten Hafit tombs and two Cell Graves. Two typical, quite disturbed Hafit tombs (Figure 5.14), and both LPTs were recorded. HC-18 is a small cemetery of five poorly preserved Hafit tombs located on a low rock hillock. Scatters of possible red

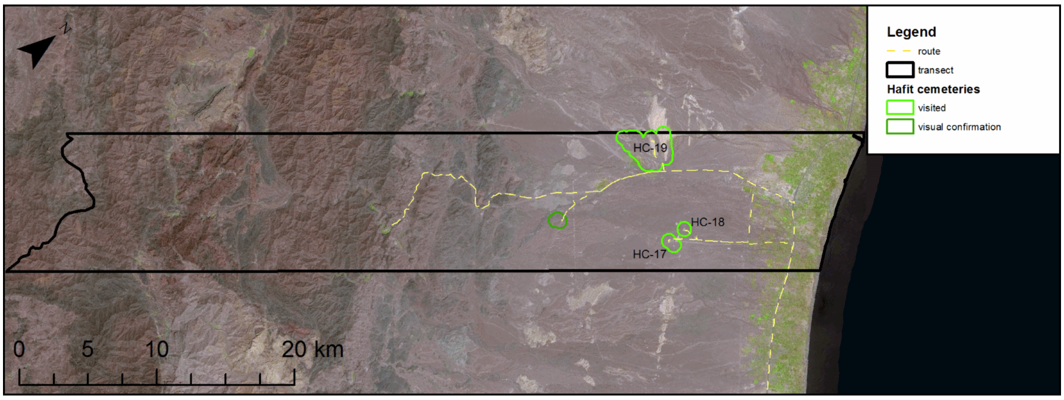


Figure 5.13: Ground-truthing fieldwork carried out at BT-3

and caramel chert debitage were observed. Two largely destroyed tombs were recorded. HC-19 is a large Hafit cemetery of hundred of tombs scattered across a range of rocky hills. Light, buff-coloured bedrock and highly contrasting, darkly-patinated wadi cobbles were used as building material. Two representative tombs were recorded.

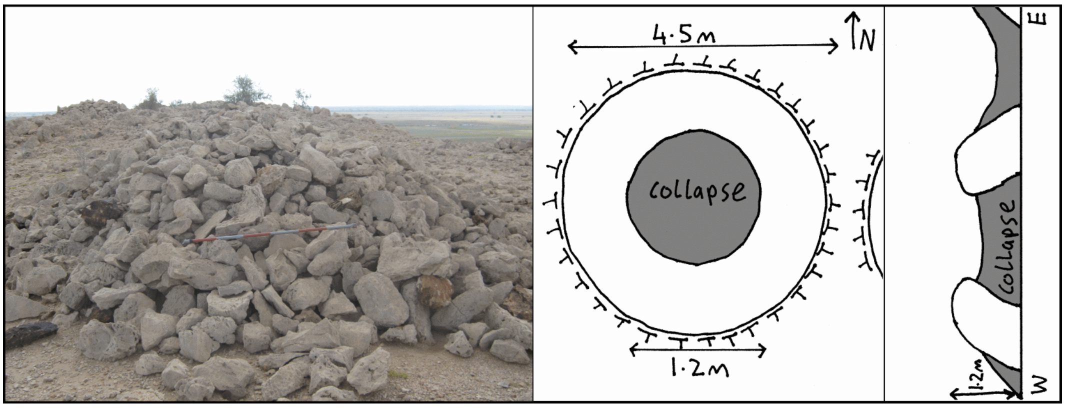


Figure 5.14: HC-17-2 — a disturbed Hafit tomb

Visual confirmation of wadi cobble Hafit tombs at the fourth possible Hafit cemetery was made while driving through the transect. A possibly Neolithic settlement site of special interest was located during the fieldwork (Appendix B.3).

BT-4: Al-Khaburah

During the B-GE transect survey a single massive cemetery of hundreds of possible Hafit tombs was found covering part of BT-4; no other Hafit or LPT funerary sites were observed. Route 9 was used to traverse the transect, but difficult terrain meant that parts of the more elevated sections could not be investigated thoroughly. During negative ground-truthing, a solitary Hafit tomb was observed that had not been located on Google Earth (Figure 5.15).

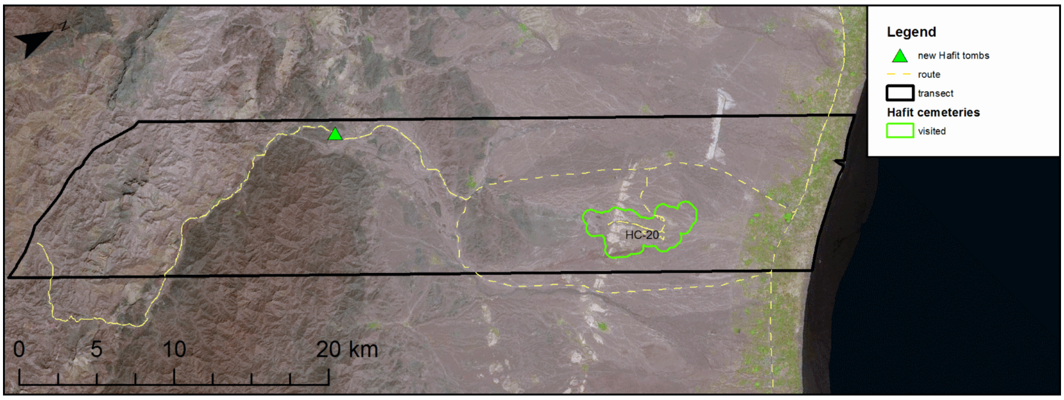


Figure 5.15: Ground-truthing fieldwork carried out at BT-4

Three dense areas of the huge suspected Hafit cemetery were examined. HC-20A proved to consist of a large cluster of Cell Graves with a much smaller number of robbed-out Hafit tomb bases. Two LPTs were recorded — one single-chambered and one multi-chambered example — as well as an example of a Hafit tomb base, surviving to only a single course above the ground surface. HC-20B was similar — a cluster of mainly single and multi-chambered Cell Graves with a small number of robbed Hafit tomb bases. Four tombs were recorded — a single and a double-chambered Cell Grave, and two Hafit tombs surviving to their lowest course (Figure 5.16). HC-20C had the same configuration — a small number of destroyed Hafit tombs, and ~30 single-chambered Cell Graves (Figure 5.17). Two examples of each were recorded.

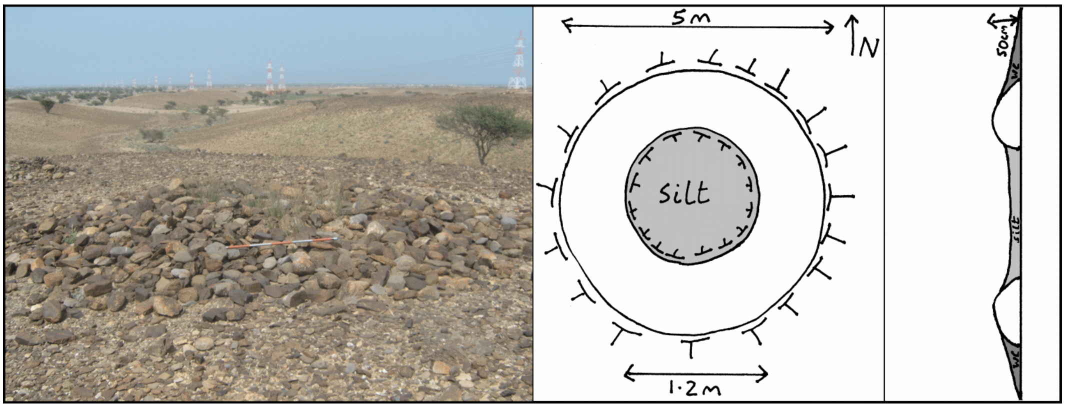


Figure 5.16: HC-20B-2 — a destroyed Hafit tomb

BT-5: Al-Suwayq

BT-5 encompassed the largest number of suspected Hafit tombs during the B-GE transect survey. The Wadi al-Haimli Road was the primary route used during negative ground-truthing of the area, along with Route 10 in the southern end. A lone pair of Hafit tombs that had not been located with Google Earth were observed (Figure 5.18).

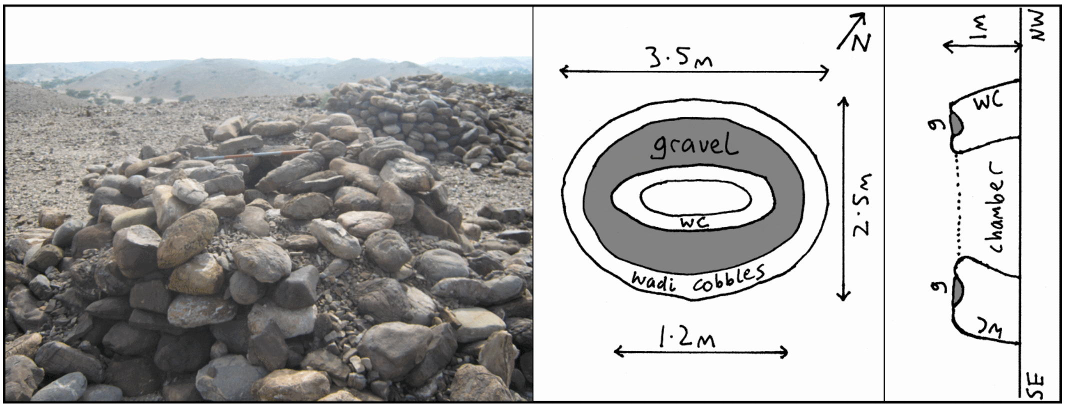


Figure 5.17: HC-20C-3 — a typical, well preserved Cell Grave

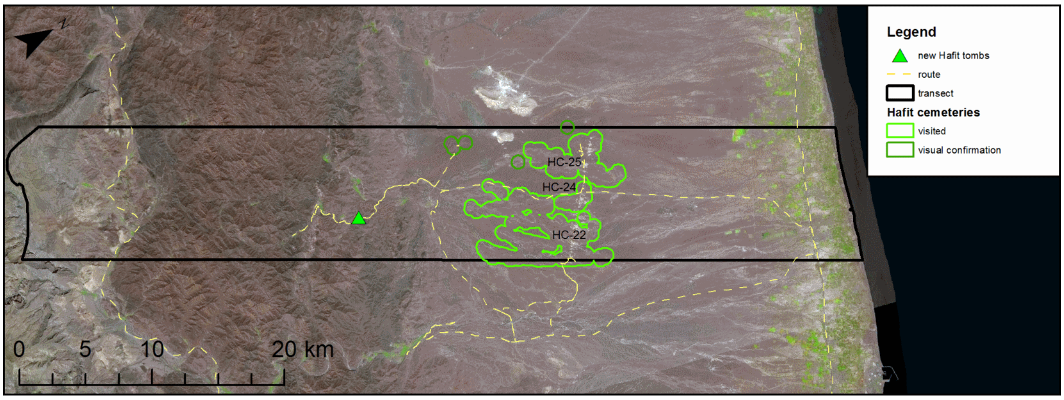


Figure 5.18: Ground-truthing fieldwork carried out at BT-5

Three Hafit cemeteries were examined in the field. HC-22 is a huge Hafit cemetery containing many hundreds of tombs distributed across a large hilly area. The tombs are constructed from darkly patinated wadi cobbles, pale buff angular bedrock sections, or a contrasting combination of the two. Two typical Hafit tombs were recorded at the site. HC-24 is a much smaller cemetery of ~20 Hafit tombs spread across a number of low rocky hillocks. The tombs are in quite poor condition and are constructed from both dark wadi cobbles and pale angular bedrock; two representative examples were recorded (Figure 5.19). HC-25 is a large cemetery of hundreds of Hafit tombs, mainly of dark wadi cobbles, but in some cases also slabs of pale buff bedrock. Many of the structures are poorly preserved but some are in much better condition. Two quite well preserved examples were recorded (Figure 5.20).

The presence of tombs was confirmed at three further possible Hafit cemeteries while passing through the transect: HC-21; HC-23; and HC-26. During fieldwork, the ephemeral, aceramic remains of a possible Hafit settlement were discovered and briefly recorded (Appendix B.3).

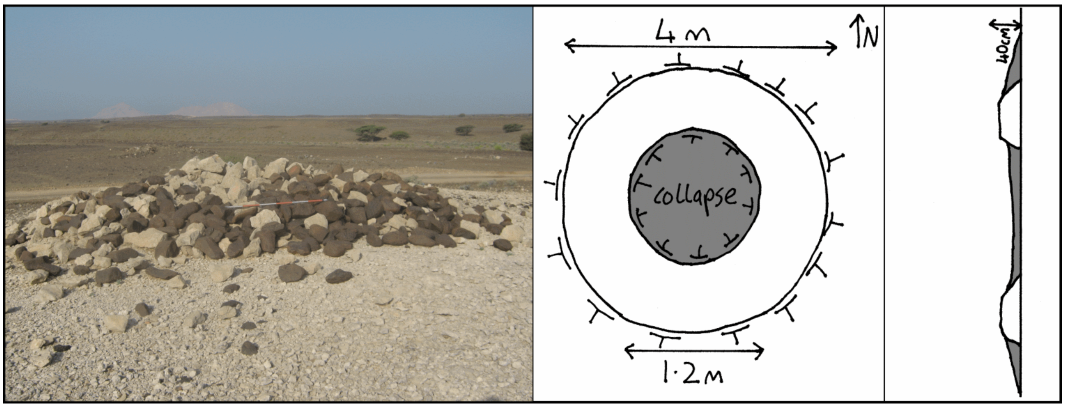


Figure 5.19: HC-24-2 — a destroyed Hafit tomb

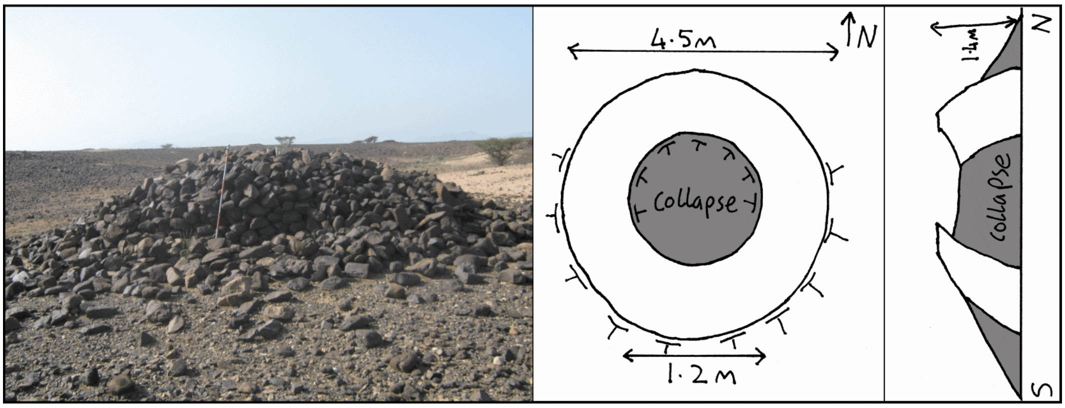


Figure 5.20: HC-25-2 — a well preserved Hafit tomb

BT-6: Al-Mussanah/Rustaq

BT-6 boasts a large number of possible Hafit cemeteries as well as two suspected LPT sites. Route 11 was used to traverse the transect as far as Rustaq, and the Wadi Sahtan road to examine the southernmost section (Figure 5.21). No Hafit cemeteries were observed that had not been located on Google Earth.

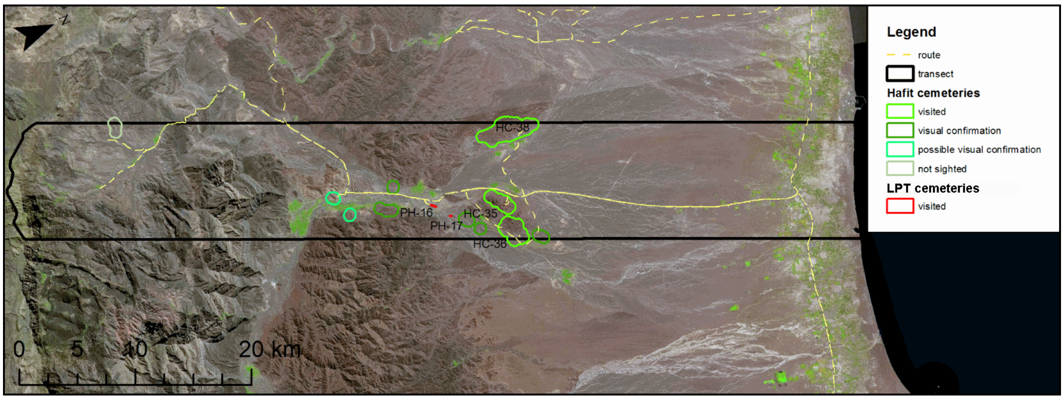


Figure 5.21: Ground-truthing fieldwork carried out at BT-6

Three of the densest Hafit cemeteries and both of the suspected LPT sites were examined in the field. HC-35 consists of a disparate cluster of Hafit tombs scattered across a range of tall ophiliote hills. Many are poorly preserved, but some at the highest points are in much better condition. Two typical, largely destroyed tombs were recorded. HC-36 is a mixed cemetery of both Hafit tombs and single and multi-chambered Cell Graves in better condition. Four tombs were recorded at the site: two representative Hafit tombs (Figure 5.22); a four-chambered Cell Grave; and a single Cell Grave. HC-38 is a sizeable cemetery of over a hundred wadi cobble Hafit tombs distributed across a large range of low hills adjacent to a substantial wadi channel. Two typical tombs were recorded. PH-16 is a small LPT cemetery of a dozen or so wadi cobble Honeycomb Tombs with irregular, probably semi-subterranean, chambers conglomerated to form 'organic' structures. Two tombs were recorded, one with 9 chambers and another with 3 (Figure 5.23). PH-17 is a LPT cemetery of more than ten tombs on a high, flat-topped ridge. The site boasts a variety of single and multi-chambered wadi cobble LPTs. One single-chambered Cell Grave was recorded (Figure 5.24), along with a very large, well preserved Honeycomb Tomb with ~15 irregularly-shaped — possibly semi-subterranean — chambers with mixed cobble/gravel walls conglomerated to form a single massive structure (Figure 5.25).

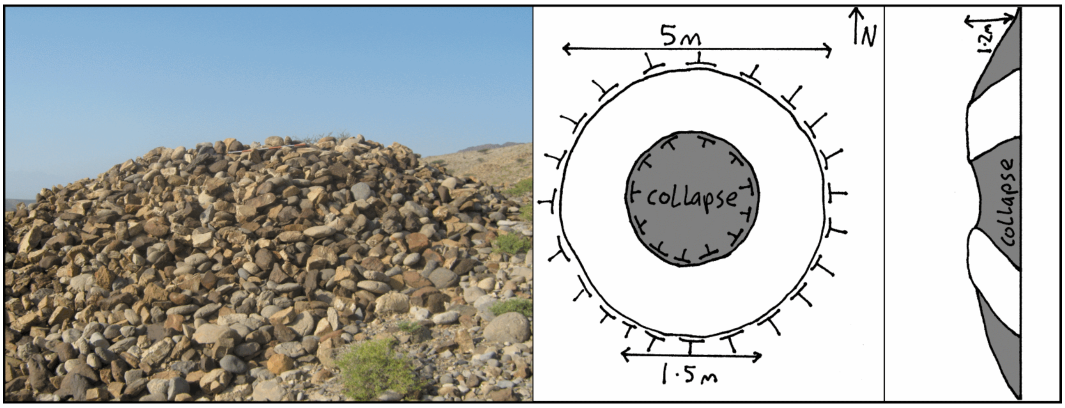


Figure 5.22: HC-36-3 — a collapsed Hafit tomb

Visual confirmation of the other suspected Hafit cemeteries was sought. Tombs were visible at five of the sites (HC-31, HC-32, HC-33, HC-34, HC-37), possibly visible at a distance — confused slightly by nearby rock outcrops — at a further two sites (HC-28, HC-30), and could not be confirmed at the only upland cemetery (HC-27).

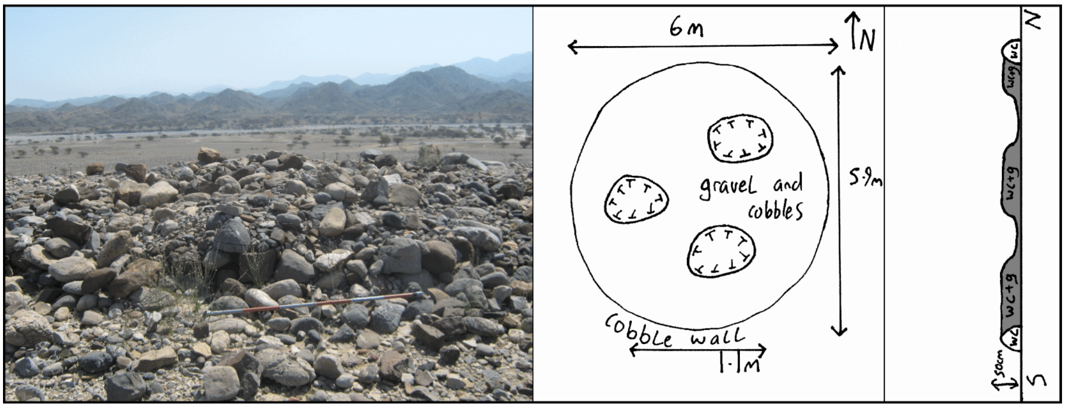


Figure 5.23: PH-16-2 — a round Honeycomb Tomb with three irregular chambers

Figure 5.24: PH-17-1 — a typical, well preserved Cell Grave

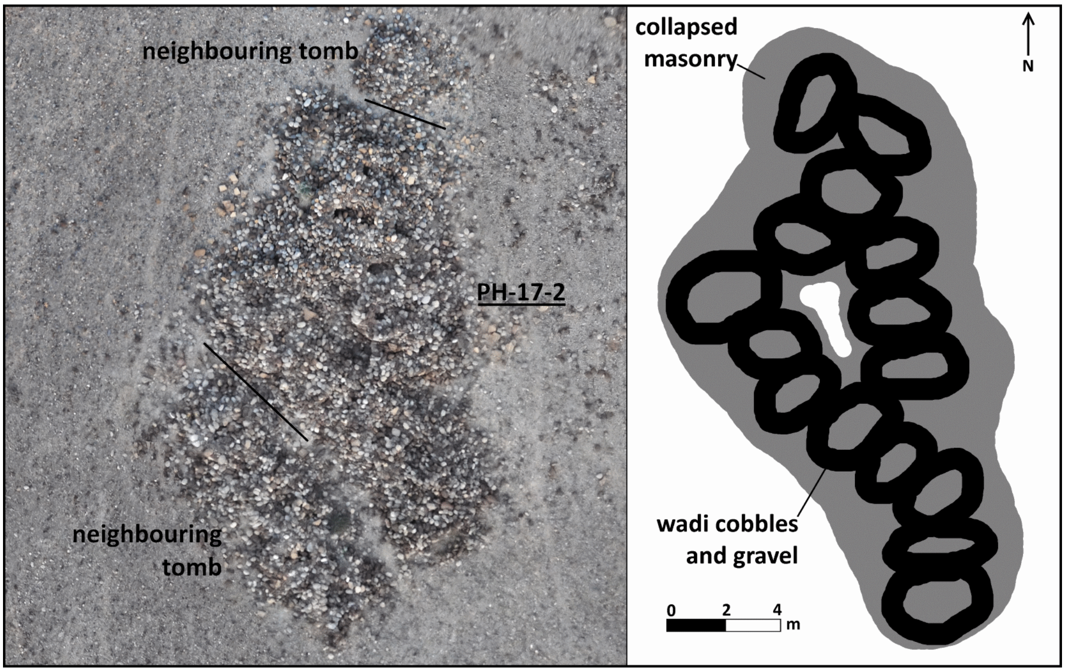


Figure 5.25: PH-17-2 — a very large Honeycomb Tomb with at least fifteen irregular chambers

5.2.3 Analysis & discussion

The objectives of this section are to test the efficacy of the 1km grid B-GE transect survey in locating Hafit tombs; to discuss the LPTs observed during the survey and ground-truthing; and to make some preliminary observations regarding the distribution of Hafit tombs in the Batinah.

The B-GE transect survey located 2,786 suspected Hafit tombs as well as 15 possible LPT cemeteries. Twenty-one suspected tomb sites (15 Hafit and six LPT) were examined in the field, and only one proved to be non-funerary: an abandoned Late Islamic settlement that had only tentatively identified as a LPT cemetery on Google Earth. As well as successfully locating tombs, the results of the 'negative' ground-truthing fieldwork strongly suggest that very few Hafit cemeteries were missed during the B-GE transect survey. Only two Hafit tomb sites — three structures in total — were observed in the field that had not been located with Google Earth (Table 5.3).

Table 5.3: Hafit tomb sites observed during fieldwork but missed in Google Earth survey

Transect	Tombs	Notes
BT-4	1	isolated Hafit tomb on ridge close to mountains
BT-5	2	two isolated Hafit tombs on ridge close to mountains

However, accurately distinguishing Hafit tombs from LPTs proved difficult using the 1km grid (Table 5.4). Three main tomb types were observed in the field: 1) Hafit tombs; 2) single and multiple-chambered Cell Graves; and 3) Honeycomb Tombs (Figure 5.26, see Chapter 4.2.1). Although some Hafit tombs were observed at 17 of the 18 possible Hafit cemeteries examined on the ground (94%), they only outnumbered LPTs at 13 of these (72%). This suggests that the 1km grid imagery resolution is too poor to reliably distinguish Hafit tombs from LPTs (Chapter 4.2), and that the methodology requires refinement before being deployed across the region as a whole.

Table 5.4: The occurence of Hafits tombs and LPTs observed at 'Hafit cemeteries'

Tombs	**Cemeteries**	**Sites**
Hafit	10	**BT-1**: HC-02, HC-07; **BT-2**: HC-13; **BT-3**: HC-18; HC-19; **BT-5**: HC-22, HC-24, HC-25; **BT-6:** HC-35, HC-38
Hafit, few LPTs	3	**BT-1:** HC-4; **BT-3:** HC-13; **BT-6:** HC-36
LPTs, few Hafit	4	**BT-2:** HC-14; **BT-4:** HC-20A, HC-20B, HC-20C
LPTs	1	**BT-2:** HC-12
Total	18	

Twenty-five LPTs were recorded at thirteen sites across the Batinah: twenty Cell Graves and five Honeycomb Tombs (Chapter 4.2.1). While these cannot shed light on Hafit society directly, as they can be mistaken for Hafit tombs they must be studied and

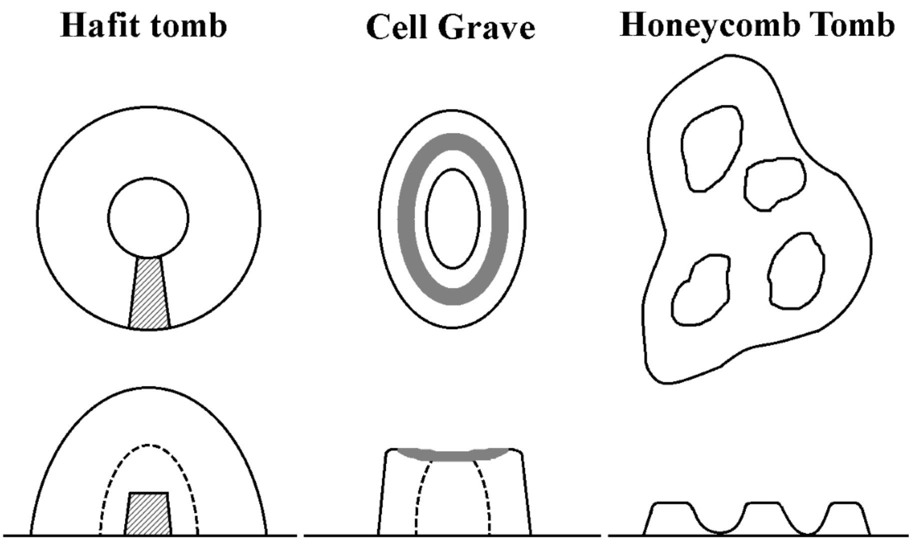


Figure 5.26: Simplified sketches of the three main tomb types observed in the field

understood. Fourteen single chambered Cell Graves were recorded, these are oval tombs between 3.5–5m long, 2.5–3.5m wide and 0.6–1.2m in height. All are constructed from wadi cobbles, which are formed into a double wall with the intervening space packed with gravel or pebbles, no effort was made to face the walls smoothly, and the outer walls slope inwards only very slightly. The chambers are oval and are accessed through a narrow elliptical entrance in the roof which is formed by the corbelling of the inner wall. Although there is no in situ evidence, it seems likely that the narrow entrance gap was bridged with slabs or long cobbles which may have been topped with gravel. Another Cell Grave is slightly more oblong than oval in shape (4x3 m) and is constructed from the local angular bedrock. Five multiple-chambered Cell Graves were also recorded, agglomerations of groups of two to six of the single-chambered units. In one case two much smaller and lower additional ovular annexes seem to have been added to a single Cell Grave in a slightly different style, and possibly therefore in a later period. Generally, Cell Graves are found in large numbers, densely spread across elevated parts of the landscape. Five Honeycomb Tombs were also recorded that have a considerably more basic construction. They mostly only reach between 40 and 50 cm in height and consist of agglomerations of small, irregularly shaped ‘chambers’ formed from a mixture of wadi cobbles (or angular bedrock slabs) and gravel. They are so small that it is likely that burial space continues beneath the surface, and that the chambers are semi-subterranean. The smallest Honeycomb consists of three ‘cells’, merged to form a rough circle approximately 6m in diameter. A slightly larger 5-celled tomb forms an oval 10x6m in size. The two other tombs are larger and form irregular, elongated tombs of 9 and 15 ‘chambers’, 17x5m and 20x10m in size. The Honeycomb Tombs were all located on hills: sometimes in small groups on their own, and in other cases in mixed cemeteries with Cell Graves, but in much lower numbers. It is unclear typologically or chronologically how these two LPT types relate to one another, but they have been reported in the Batinah and elsewhere in the northern Oman Peninsula and both probably date to the Early or Late Iron Age (Chapter 4.2.1).

The B-GE transect survey results provide some early observations regarding the distribution of Hafit tombs in the Batinah. The existence of the 'Batinah band' observed during the NOP-GE survey has been confirmed — Hafit tombs are concentrated between the coastal plains and the mountains, with only a small number very far from the sea. The tombs prefer the Quaternary fluvial formations and Tertiary rocky deposits in the low bajada foothills. There is a strong relationship between Hafit tombs and LPTs, both are frequently found in the same cemeteries, and evidence of the reuse of Hafit tomb masonry in later tombs was observed repeatedly.

With regards to the methodology, very few Hafit tombs were observed on the ground that were not located in Google Earth. This suggest that 1km grid Google Earth survey is effective at locating Hafit tombs. However, the results also suggest that they cannot be reliably distinguished from LPTs at this level of magnification (Chapter 4.2). By refining the methodology and using the B-GE transect data, it should be possible to improve the accuracy of the survey (Chapter 4.2), before it is deployed across the whole of the Batinah region.

5.3 Full Batinah Google Earth survey

This chapter's primary objective is to generate an accurate map of Hafit tombs in the Batinah. This dataset will be analysed with GIS to model the distribution of tombs and shed light on the Hafit period occupation of the region. Having trialled the methodology and collected data on the regions LPTs, the B-GE survey method will be refined and then expanded across the entirety of the Batinah.

The Batinah covers a huge area, so as a compromise between total survey time and accuracy a two-stage method was devised for the full B-GE survey. A 1km grid survey was used to locate suspected Hafit and LPT cemeteries, and these areas were resurveyed at a higher magnification using a 12 arcsecond grid to distinguish between tomb types. This was facilitated through the use of a reference collection of satellite imagery of Hafit and LPT cemeteries recorded during the B-GE transect survey fieldwork. To assess the reliability of this approach, the results were ground-truthed in the field (Chapter 4.2).

5.3.1 Method

A grid was created — excluding the areas already covered during the transect survey — for the 1km Batinah Google Earth (1km B-GE) survey and imported into Google Earth (Figure 5.27)[4]. With the width of the square filling the computer screen, the viewing window was moved from north to south along the length of each column of the grid in turn. Suspected Hafits tombs and LPTs were marked with **placemarks**, and the **Historical Imagery Tool** was used to ensure that the best quality satellite imagery available was used. The survey area for the second stage of the survey was defined by creating a 2km buffer zone around these suspected Hafit tombs and LPTs after they were merged with the results of the B-GE transect survey[5].

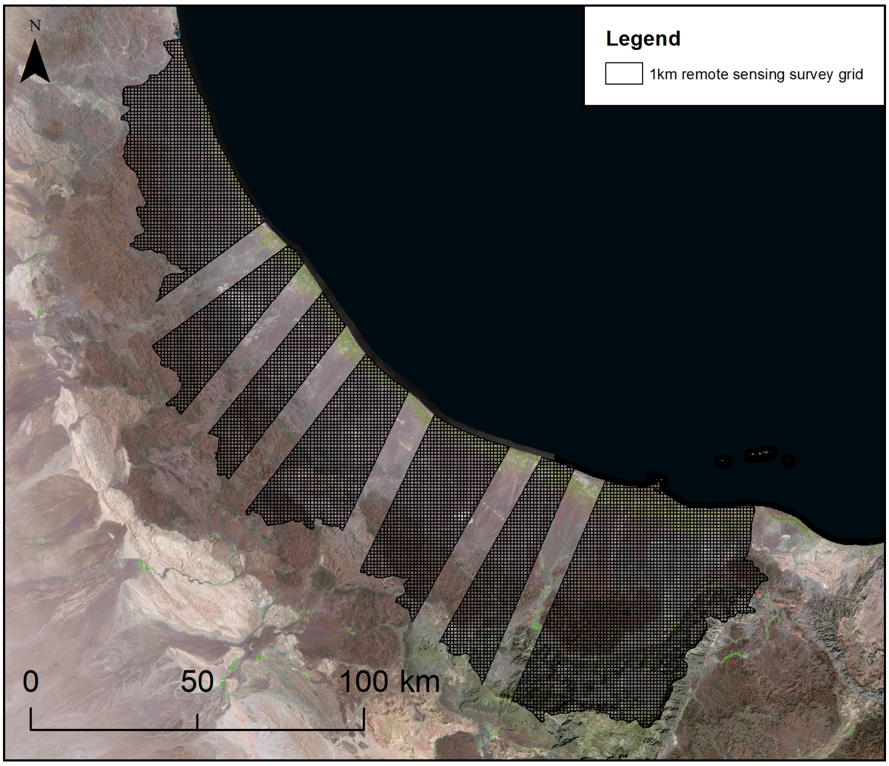


Figure 5.27: The 1km grid used during the first stage of Batinah remote sensing survey

Before carrying out the second, 12 arcsecond phase of the Batinah Google Earth (12" B-GE) survey, a satellite imagery reference collection of known Hafit and LPT sites was produced. Google Earth was used to harvest the best possible imagery — using the **Historical Imagery Tool** — from a selection of sites visited during transect survey ground-truthing. This was printed to help distinguish Hafit tombs from LPTs (Figure

[4]a 1km grid was generated in ArcGIS using the **Create Fishnet Tool**, **clipped** to the shape of the Batinah, and the transect areas were removed using the **Erase Tool**; the resulting feature was exported to Google Earth using the **Layer to KML Tool**

[5]using the **Merge Tool** and **Buffer Tool** in ArcGIS

5.28). At sufficiently high-magnification Hafit tombs can be distinguished from LPTs as they are larger and more round than single Cell Graves, and are detached structures unlike Honeycomb Tombs and multi-chambered Cell Graves (see Chapter 4.2).

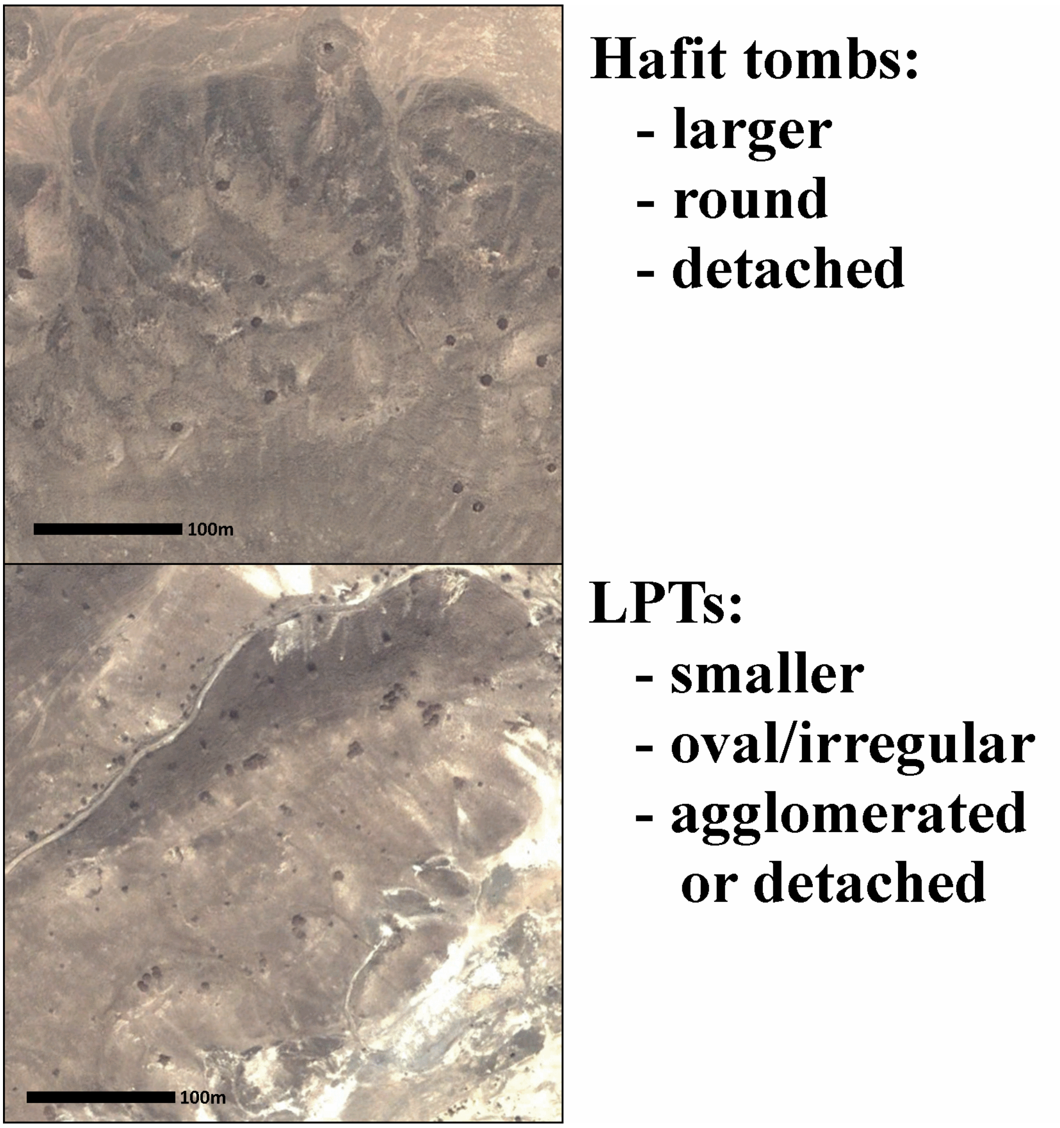


Figure 5.28: Two examples from the reference satellite imagery collection of Hafit and LPT cemeteries from the transect survey

The 12" B-GE survey phase used Google Earth's native 12 arcsecond grid to resurvey areas containing Hafit tombs and LPTs at higher magnification (Figure 5.29), using the standard methodology. No effort was made to distinguish between LPTs types. The survey was carried out 'blind', without reference to the 1km B-GE survey data or the B-GE transect survey results.

To test the 12" B-GE survey results, a sample of Hafit tombs and LPTs were examined and recorded in the field. 25 Hafit and 25 LPT cemeteries were randomly selected. An overly large number were selected to ensure that sufficient tombs would be

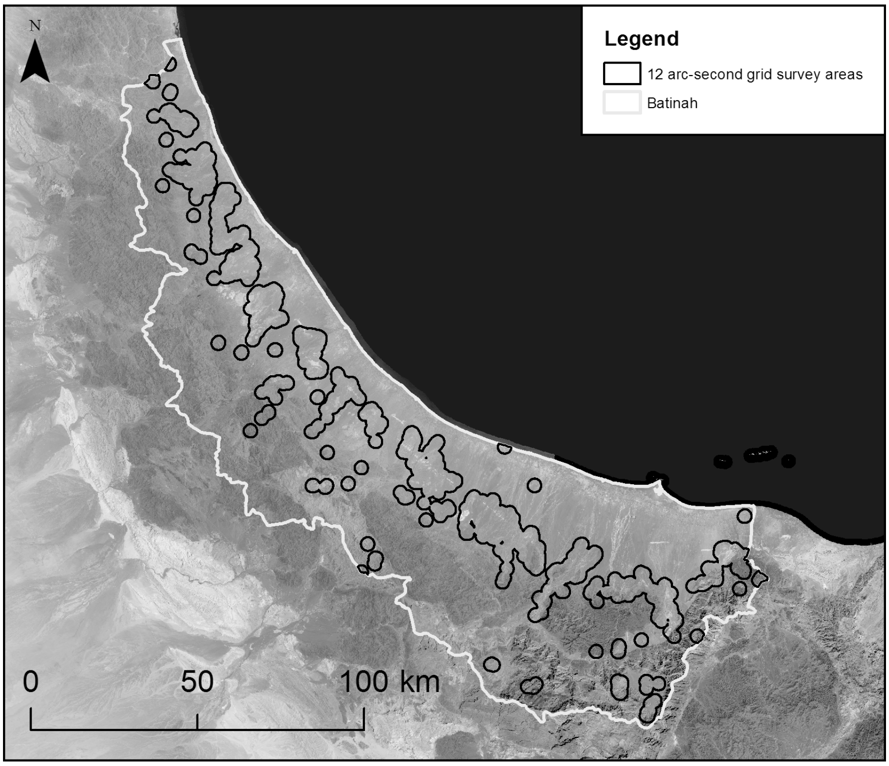


Figure 5.29: Areas resurveyed at higher resolution in the 12" B-GE survey

recorded if some cemeteries could not be reached. Two tombs were recorded at each site using a standardised record sheet including: GPS coordinates; site description; tomb description; basic dimensions; sketches in plan and section; and surface find observations. Photographs of each tomb and the surrounding site were also taken. In recording a tomb's type, a likelihood index was used in order to indicate any ambiguity in form or uncertainty in identification (e.g. Hafit, Hafit?, Unknown, Cell Grave?, Cell Grave etc).

5.3.2 Results

In the 1km B-GE survey a further 6,382 suspected tombs were located (Figure 5.30). The majority marked as Hafit tombs (4,592), with a smaller number suspected to be LPTs (1,790). Both types were found throughout the survey area, but the suspected Hafit tombs in greater numbers in the southeast and the LPTs denser in the northwest.

During the 12" B-GE survey 14,888 possible tombs were identified, including 6,390 suspected Hafit tombs and 8,498 LPTs (Figure 5.31). The Hafit tomb distribution conforms to the 'Batinah band' pattern already observed, with very few tombs situated in the mountains or on the plain. The LPTs follow a similar pattern, but show a slightly wider distribution. These datasets will be analysed in much greater detail later.

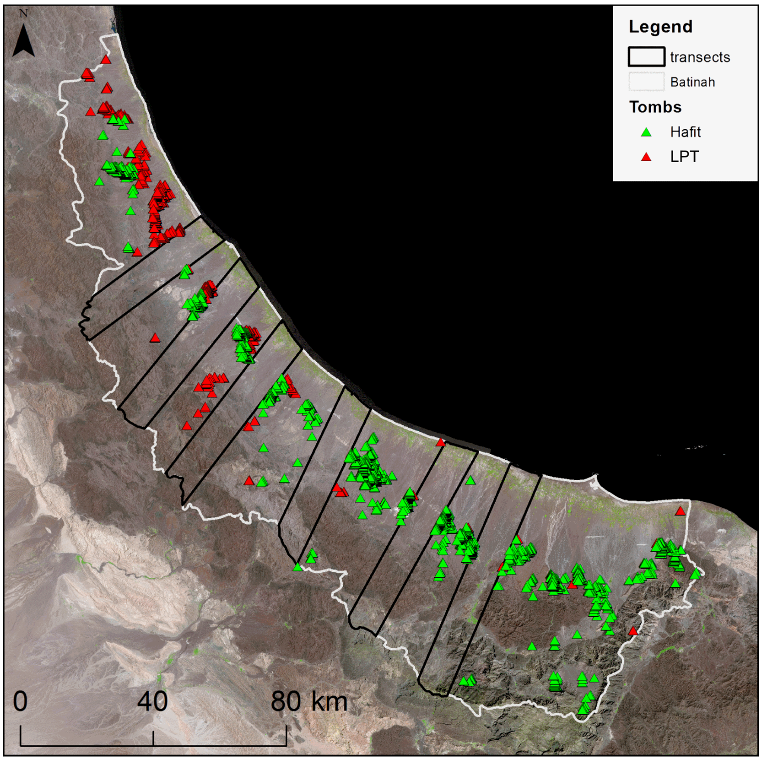


Figure 5.30: Suspected Hafits tombs and LPTs located during the first phase of data collection, the 1km B-GE survey

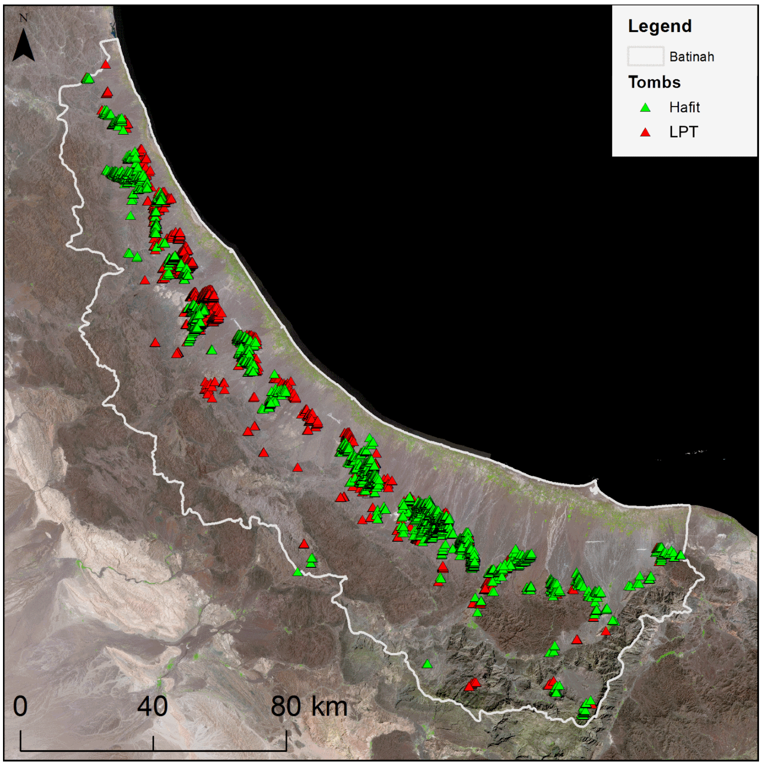


Figure 5.31: Suspected Hafit tombs and LPTs located during the second phase of data collection, the 12" B-GE survey

25 suspected Hafit and 25 LPT sites were randomly selected for ground-truthing. 34 of these 50 sites were examined on the ground (Figure 5.32) — the remaining sixteen were not, due to time constraints, a lack of legal access to land, or problems crossing difficult terrain. The fieldwork was carried out over five trips (Table 5.5).

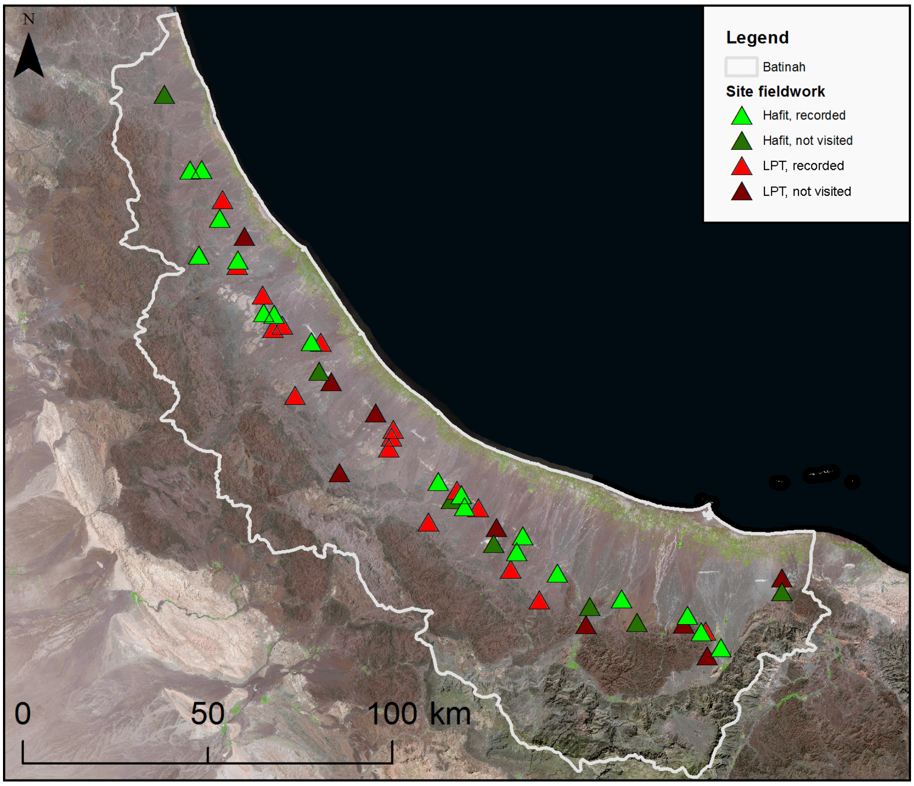


Figure 5.32: Sites recorded and not visited during ground-truthing fieldwork

Table 5.5: Sites visited during ground-truthing of the second phase of the Google Earth survey

Date	*Wilayat*	Hafit	LPT
09–10/02/2015	Shinas, Liwa, Sohar	8	6
16/02/2015	Saham, Khaborah	0	4
17/02/2015	Khaborah, Suwaiq	3	3
18/02/2015	Suwaiq, Rustaq	4	2
19/02/2015	Nakhal, Wadi al Mawil	3	1
Total		18	16

In total, 66 tombs were recorded (Table 5.6). The results are presented in full elsewhere (Appendix B.2), and are summarised below.

Table 5.6: The number of tombs recorded at suspected Hafit tomb and LPT sites

Hafit		LPT	
site	tombs	site	tombs
H-02	2	P-03	2
H-03	2	P-06	2
H-04	2	P-07	1
H-06	2	P-09	2
H-08	2	P-10	2
H-09	2	P-11	2
H-10	2	P-12	2
H-12	2	P-13	2
H-13	2	P-14	2
H-15	2	P-18	1
H-17	2	P-19	2
H-18	2	P-20	2
H-19	2	P-21	2
H-20	2	P-22	2
H-21	2	P-24	2
H-22	2	P-25	2
H-23	2		
H-24	2		
Total	36		30

18 suspected Hafit cemeteries were examined from across the Batinah (Figure 5.33). There is considerable variation between the sites, but a number of clear patterns emerge (Table 5.7). Cemetery size varies considerably from lone pairs of tombs to large necropolises with hundreds of funerary structures. Although the condition of the tombs was variable, the vast majority were positively identified as Hafit tombs — at only two sites were they in too poor a condition to categorise. Hafit tombs were constructed from wadi cobbles at the vast majority of the sites, although in some cases angular bedrock pieces were used, or a combination of the two. Building material generally reflected the local geology — cemeteries are most often constructed on Quaternary hills and terraces, although rocky outcrops and ridges were also frequently used. Many of the sites were located on high ground, overlooking sizeable wadi channels. Relatively few surface finds were observed at the Hafit sites; chert was the most common, although only one piece was clearly anthropogenic (Figure 5.34); Late Islamic redware was also common.

A total of 36 tombs was recorded at the suspected Hafit cemeteries. The vast majority were clearly or probably of Hafit type, only four were so badly disturbed that it was not possible to judge their architecture (see Chapter 4.2), though even these examples were more most closely akin to Hafit tombs (Figures 5.35, 5.36). All of the tombs recorded were either circular or marginally sub-circular (Figure 5.37), with the difference between the two perpedicular diameter measurements less than 80cm at the most. Although the size of the tombs varies considerably — the smallest 2.6m and the largest 8.7 in diameter

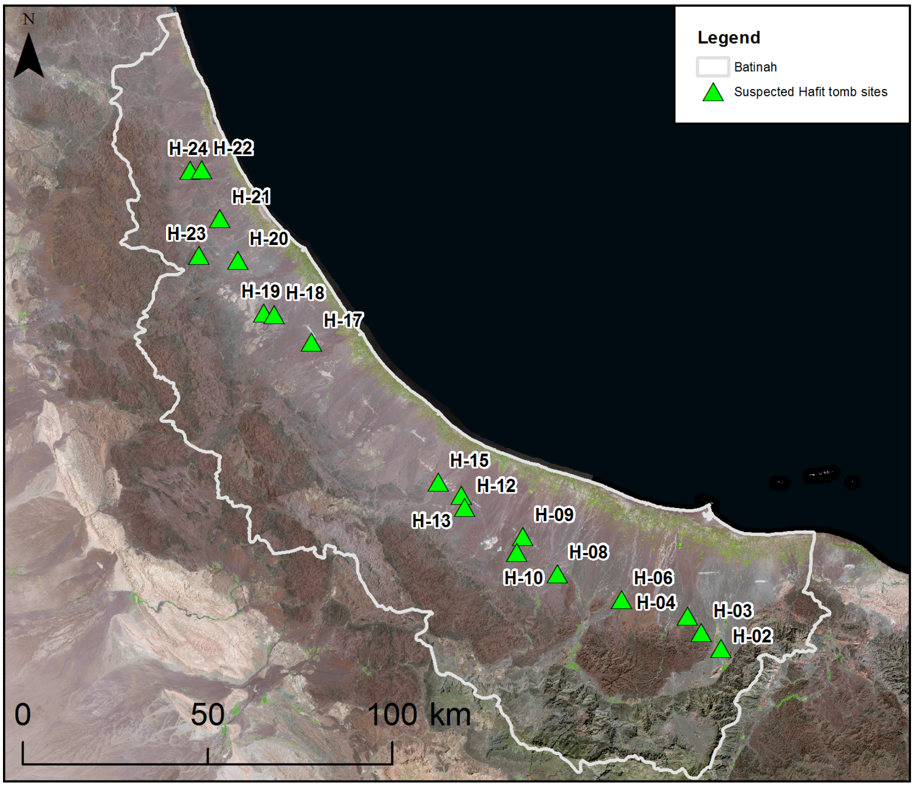


Figure 5.33: Suspected Hafit tomb sites visited during ground-truthing of the second phase of the Google Earth survey

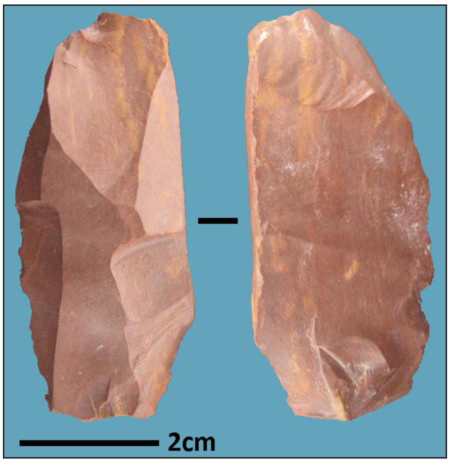


Figure 5.34: A possible red chert tool found at a Hafit cemetery

— the vast majority fall between 4 and 6m (Figure 5.38). Where chambers were not obscured by rubble, invisible due to severe stone robbing, or hidden by well-preserved walls, they were circular and between 1.5 and 2.5m in diameter (Figure 5.39). The tombs in the best condition survive to a height of ~2m or more (Figures 5.40, 5.41), the most disturbed survive to less than a metre, for most a height of between 1 and 1.5m was typical. Entrances were only visible in two tombs: H-19-1's was oriented to the northwest and H-21-2's to the south-southeast (Figure 5.42). A small number of the Hafit tombs were

Table 5.7: Suspected Hafit sites recorded during ground-truthing

Site	Description	Setting
H-02	small group of 15–20 destroyed tombs; wadi cobbles; Late Islamic redware	low Quaternary terrace overlooking small wadi
H-03	~10 Hafit tombs; angular bedrock pieces; no finds	tall upholding ridge, part of a range of hills
H-04	~5 badly disturbed tombs; wadi cobbles; no finds	low/medium Quaternary terrace overlooking sizeable wadi
H-06	15–20 badly preserved Hafit tombs; wadi cobbles and angular bedrock slabs; Late Islamic redware and red chert	tall Tertiary outcrop
H-08	cluster of 5 Hafit tombs in cemetery of 100s; wadi cobbles; no finds	across a range of Quaternary hills overlooking sizeable wadi bed
H-09	~10 badly disturbed Hafit tombs; wadi cobbles and pale angular bedrock slabs; no finds	Tertiary hill outcropping from gravel plain
H-10	15–20 Hafit tombs; wadi cobbles with some sandstone slabs; no finds	base, slopes and ridge of Quaternary hill, part of site of al-Buyraq (Chapter 7)
H-12	~50 Hafit tombs; wadi cobbles with some angular bedrock slabs; red chert	tall Quaternary hill overlooking a large wadi plain
H-13	20–30 badly disturbed Hafit tombs; wadi cobbles and angular bedrock pieces; no finds	medium Quaternary terrace overlooking a large wadi and aeolian deposits
H-15	~50 disturbed Hafit tombs; unworked angular bedrock pieces; 20th century porcelain	Quaternary terrace overlooking a large wadi
H-17	~10 Hafit tombs, part of a cemetery of 100s of others; wadi cobbles; caramel chert	very tall Quaternary terrace overlooking a large wadi
H-18	20–30 Hafit tombs, part of a cemetery of 100s of others; wadi cobbles; Late Islamic redware and red chert	lower slopes of a tall range of Quaternary hills
H-19	10 Hafit tombs and several Cell Graves; wadi cobbles and angular bedrock; red chert including tool?	low Quaternary terrace adjacent to a large wadi
H-20	~20 Hafit tombs, part of a cemetery of 100s of Hafit and later tombs; wadi cobbles and pale, angular bedrock slabs; no finds	series of tall Cretaceous rocky ridges
H-21	20–30 Hafit tombs; angular bedrock slabs; no finds	tall rocky hill at interface between Quaternary and ophiolite
H-22	~10 Hafit tombs; wadi cobbles; red and grey chert	flat top of tall Quaternary hill
H-23	lone pair of Hafit tombs; wadi cobbles; no finds	low Quaternary terrace overlooking a wadi
H-24	~5 Hafit tombs; wadi cobbles; Late Islamic redware, red and orange chert	low Quaternary hill overlooking a wadi

remodelled in later periods: H-17-2 boasts a low platform of silt and wadi cobbles — probably the lowest courses of a Hafit tomb — over 6m in diameter, on which was built an oval ‘long barrow’ of wadi cobbles, probably the masonry of the original structure (Figure 5.43); the roof and walls of H-22-2 had largely collapsed, but the rubble appears to have been adapted into a Honeycomb Tomb with three chambers (Figure 5.44).

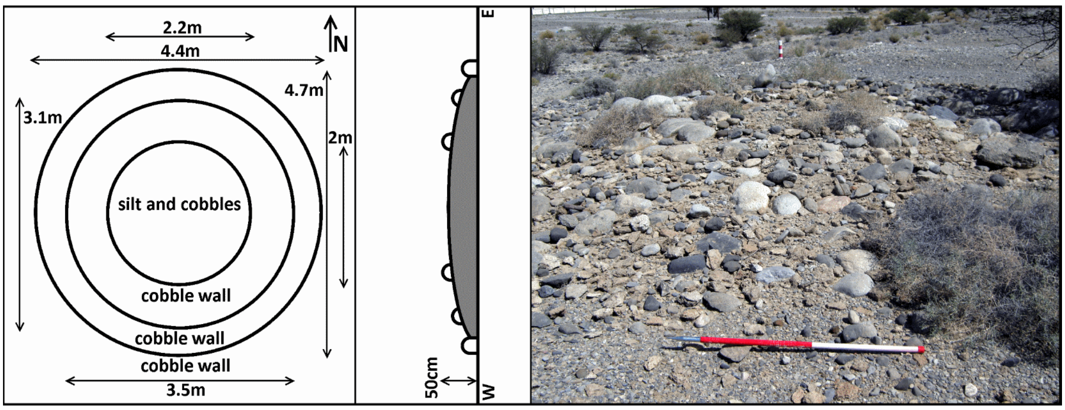


Figure 5.35: H-02-1 — a badly disturbed tomb of unknown type

Table 5.8: *Characteristics of tombs recorded at suspected Hafit tomb sites*

Tomb	Type	Condition	Diameter (m)	Chamber (m)	Height (m)
H-02-1	unknown	very badly disturbed	5.5–5.3	–	0.3
H-02-2	unknown	very badly disturbed	4.7–4.4	2.2–2.0	0.5
H-03-1	Hafit	very well preserved	4.6–4.4	–	1.6
H-03-2	Hafit	very well preserved	8.7–8.5	–	2.5
H-04-1	unknown	very badly disturbed	4.6–4.4	1.8–1.7	0.8
H-04-2	unknown	badly disturbed	5.0–4.7	1.9–1.7	0.7
H-06-1	Hafit?	badly disturbed	4.4–4.3	–	0.9
H-06-2	Hafit?	badly disturbed	4.7–4.5	–	0.7
H-08-1	Hafit	disturbed	4.9–4.8	1.9	1.2
H-08-2	Hafit	well preserved	2.6–2.5	1.4–1.2	1.3
H-09-1	Hafit?	disturbed	4.6–4.2	1.6–1.4	0.9
H-09-2	Hafit?	badly disturbed	5.9–5.5	–	0.5
H-10-1	Hafit	quite well preserved	4.6–4.5	1.9–1.7	1.2
H-10-2	Hafit	quite well preserved	4.1	2.0–1.9	1.2
H-12-1	Hafit	disturbed	5.8–5.0	2.1–2.0	1.1
H-12-2	Hafit	disturbed	4.4–4.2	2.1–2.0	1.1
H-13-1	Hafit?	badly disturbed	5.2–5.1	2.2–2.0	1.0
H-13-2	Hafit	disturbed	4.7–4.3	2.1–2.0	1.1
H-15-1	Hafit?	badly disturbed	5.7	1.9–1.8	0.4
H-15-2	Hafit?	disturbed	5.5	2.1–1.9	0.8
H-17-1	Hafit?	badly disturbed	5.5–4.7	–	0.9
H-17-2	Hafit?	quite well preserved	6.4–6.2	–	1.4
H-18-1	Hafit?	badly disturbed	4.0–3.9	–	0.7
H-18-2	Hafit	quite well preserved	5.5–5.4	2.5–2.3	1.5
H-19-1	Hafit	very well preserved	7.5–7.0	–	2.0
H-19-2	Hafit?	badly disturbed	4.3	–	0.8
H-20-1	Hafit?	disturbed	4.1–3.9	–	1.0
H-20-2	Hafit?	disturbed	4.0	–	0.9
H-21-1	Hafit	very well preserved	5.6–5.5	–	1.8
H-21-2	Hafit	very well preserved	5.1	–	1.8
H-22-1	Hafit	quite well preserved	5.6–5.3	–	1.3
H-22-2	Hafit	disturbed	5.9	–	1.0
H-23-1	Hafit	disturbed	3.5	–	1.1
H-23-2	Hafit	disturbed	3.5	–	1.1
H-24-1	Hafit	disturbed	5.4–4.9	–	1.2
H-24-2	Hafit	quite well preserved	6.9–6.2	–	1.8

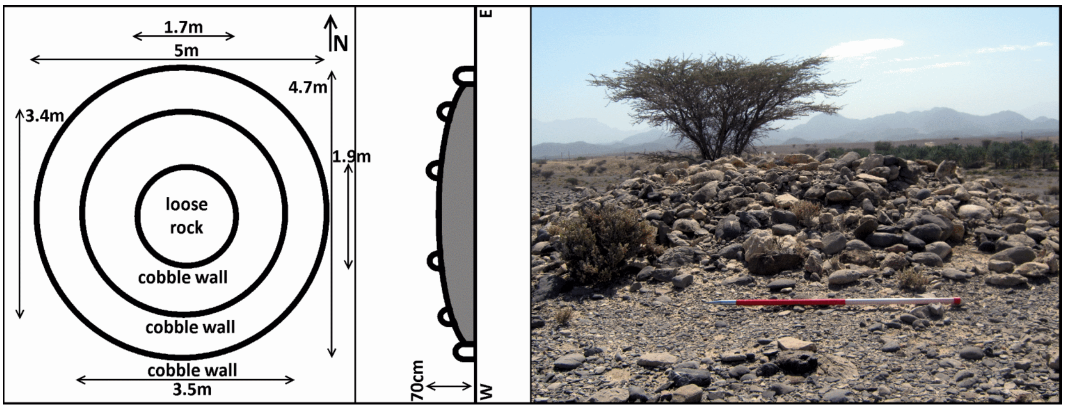


Figure 5.36: *H-04-2 — a badly disturbed tomb of unknown type*

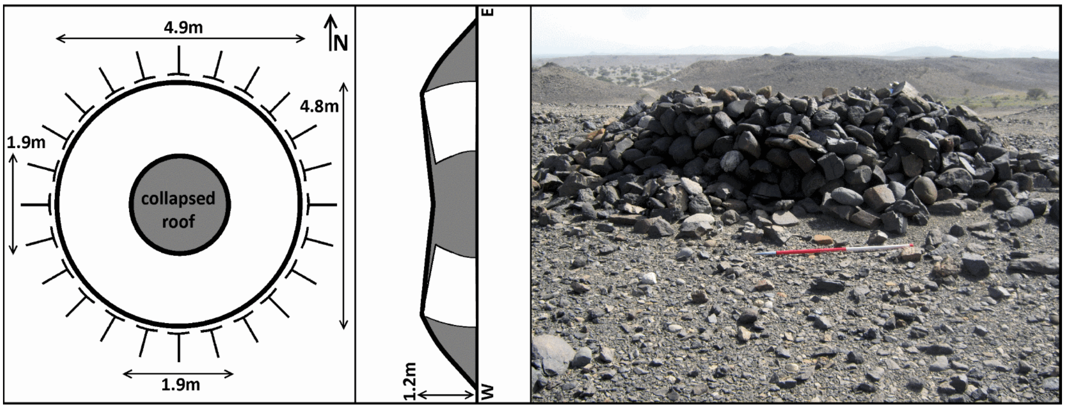


Figure 5.37: H-08-1 — a Hafit tomb in quite good condition

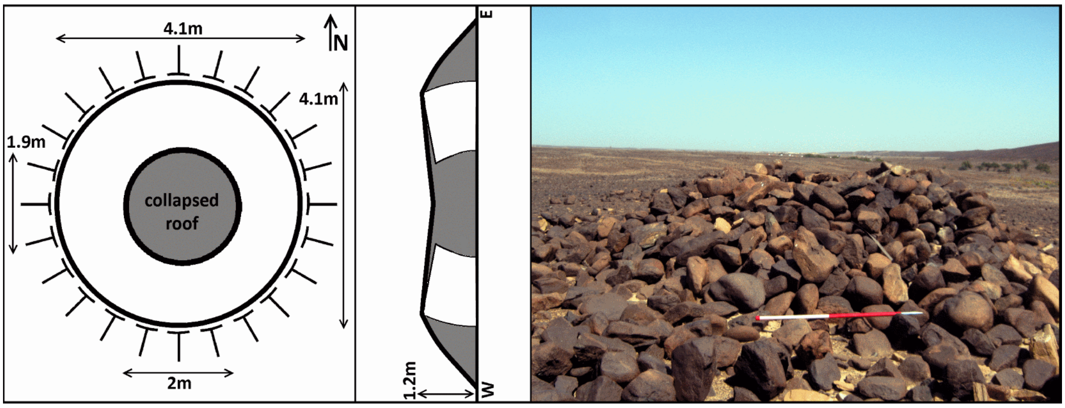


Figure 5.38: H-10-2 — a Hafit tomb in quite good condition

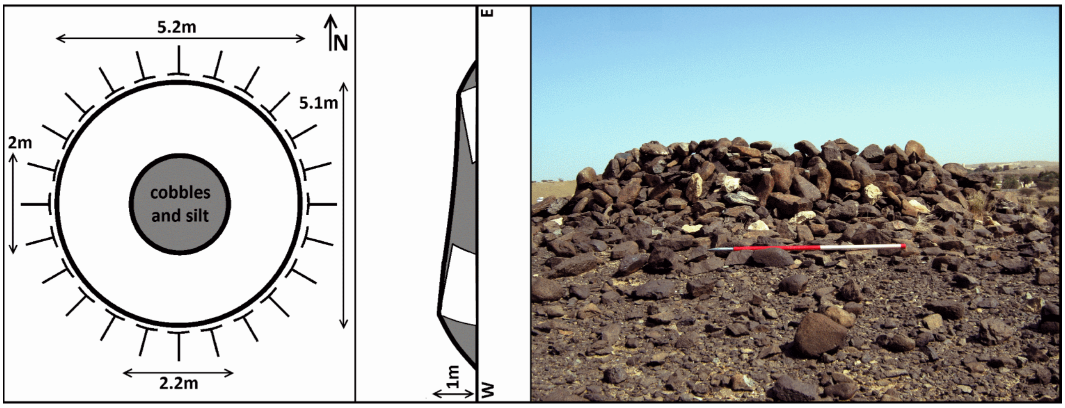


Figure 5.39: H-13-1 — a Hafit tomb in quite good condition

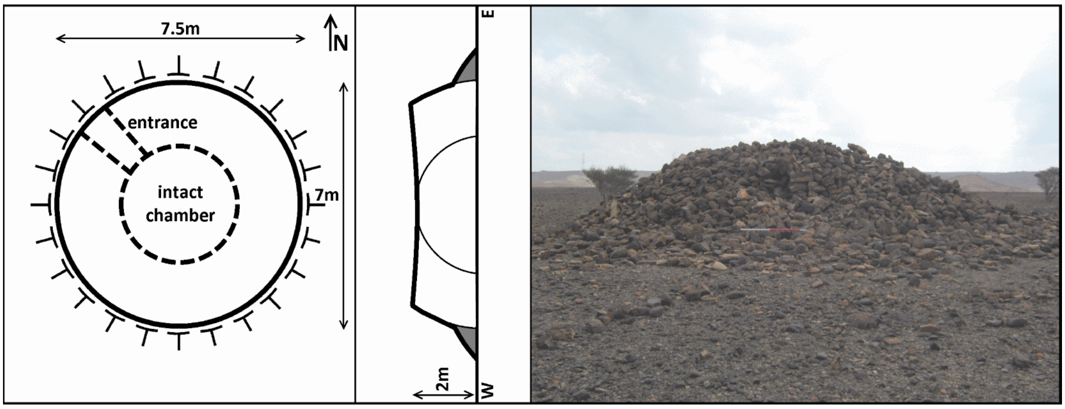


Figure 5.40: H-19-1 — a Hafit tomb in good condition with a partly-surviving entrance

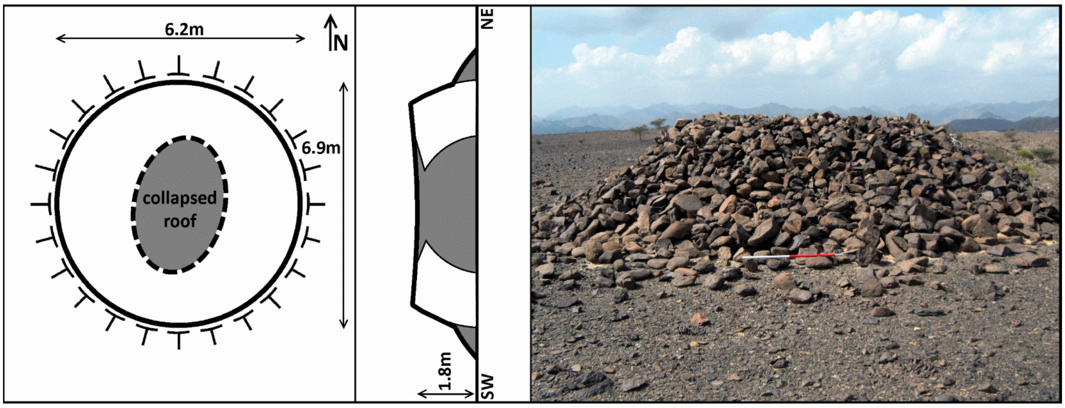


Figure 5.41: H-24-2 — a Hafit tomb in very good condition

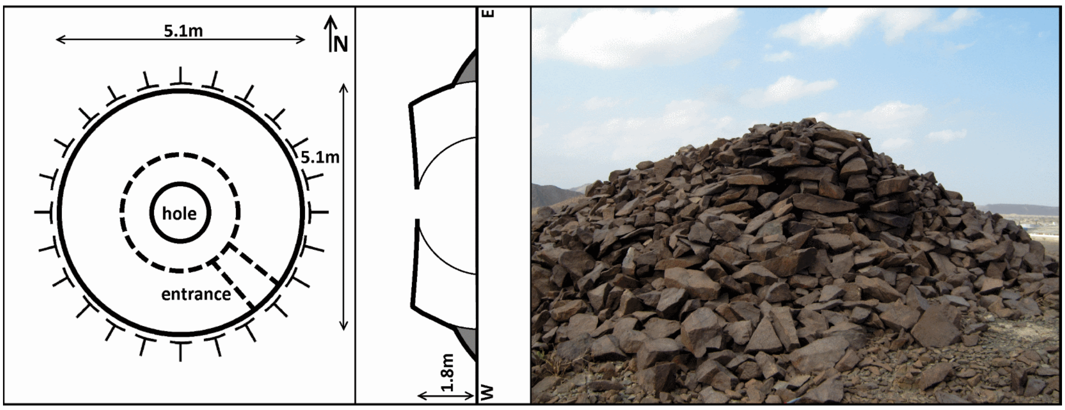


Figure 5.42: H-21-2 — a Hafit tomb in good condition with a surviving, blocked entrance

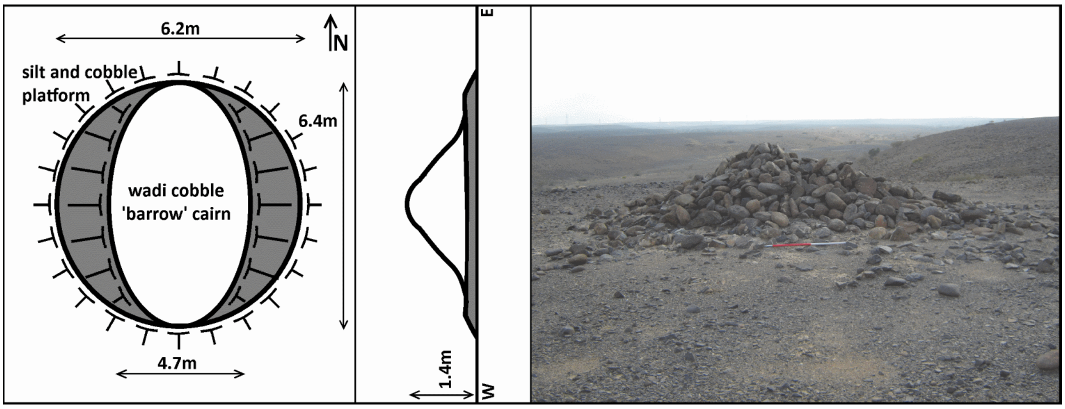


Figure 5.43: H-17-2 — a Hafit tomb later remodelled into a long barrow shaped-cairn

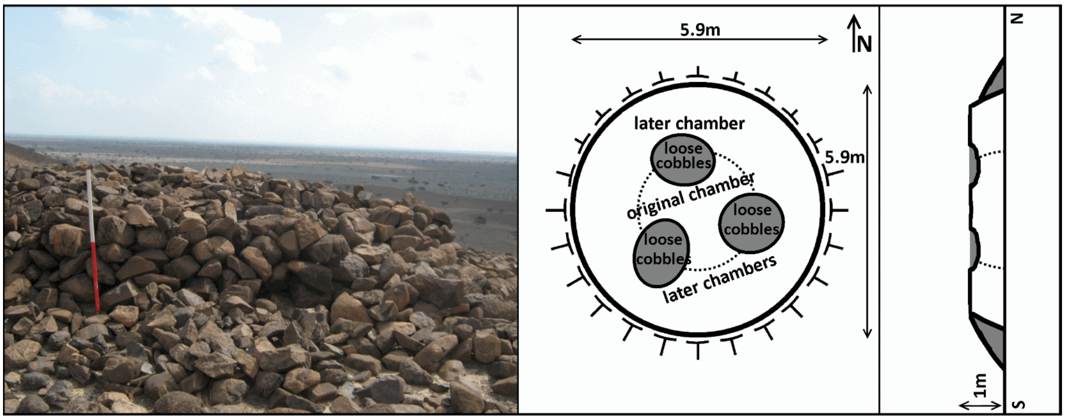


Figure 5.44: H-22-2 — a Hafit tomb later remodelled into a three-chambered Honeycomb Tomb

Sixteen suspected LPT cemeteries were examined in the field (Figure 5.45), showing both considerable variety and recurring patterns in architecture and distribution (Table 5.9). In general, LPTs usually form sizeable clusters of between 10 and 30 structures, although a lone tomb was observed as well as larger collections of fifty to a hundred structures. They are less likely than Hafit tombs to form part of a wider cemetery, with half of the cemeteries being fairly isolated. The vast majority boasted tombs clearly of a known LPT type, but in one case a Hafit cemetery had been drastically remodelled in a later period, and another consisted of structures of unknown form and function. The tombs were largely constructed of a combination of wadi cobbles or angular bedrock pieces, and gravel or small stones (Figures 5.46, 5.47). Relatively few surface finds were observed: Late Islamic pottery was fairly common; pottery from other periods was unusual but included Turq, Iron II and Bronze Age sherds; chert was much less common than at Hafit sites. The suspected LPT sites were largely located on Quaternary terraces and hills of varying height, but they were also positioned on older conglomerates, and rocky ophiolite and Hawasina hills and outcrops. Fewer were found in close proximity to wadi channels than the Hafit sites.

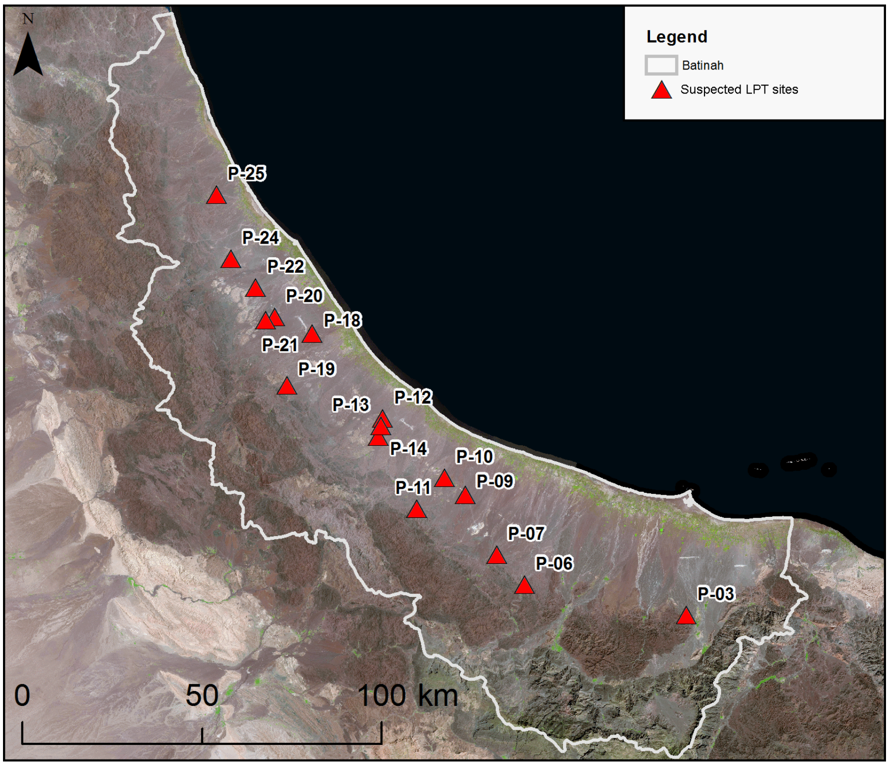


Figure 5.45: Suspected LPT sites visited during ground-truthing

Thirty tombs were recorded at the suspected LPT cemeteries. The vast majority of these were clearly or probably Cell Graves (Figures 5.48, 5.49, 5.50), smaller numbers of Honeycomb Tombs and Wadi Suq tombs were also recorded (Figure 5.51), as well as an

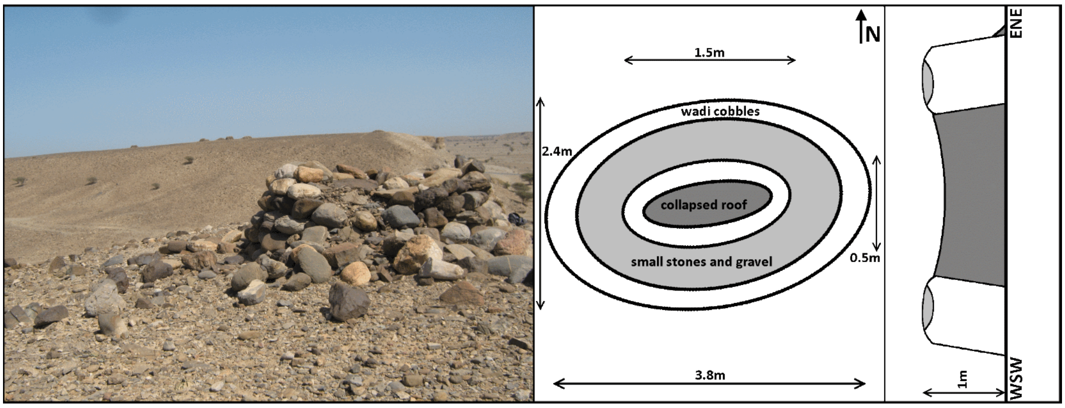


Figure 5.46: P-14-2 — a Cell Grave constructed from wadi cobbles and gravel

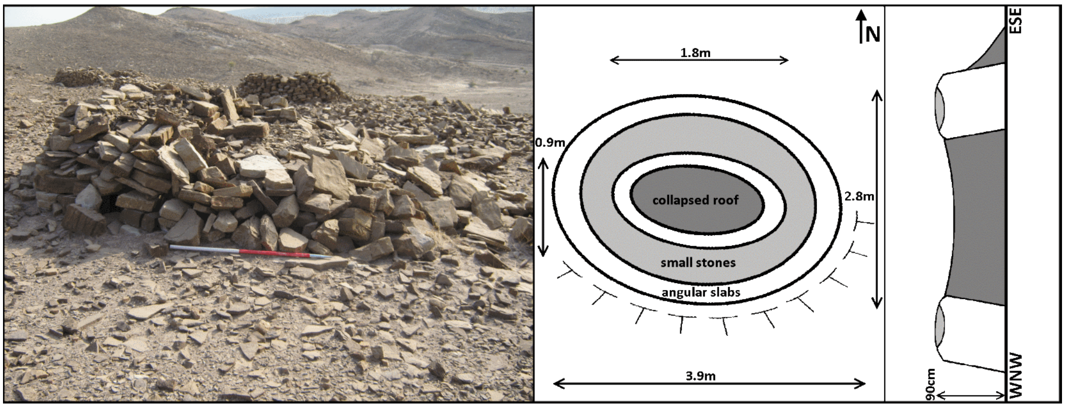


Figure 5.47: P-24-2 — a Cell Grave constructed from angular slabs and small stones

entirely unknown form. The majority of the LPTs are in a good condition — some are near-perfect (Figure 5.52), while relatively few had been disturbed, and only one almost completely destroyed. The Cell Graves were oval in shape, usually ~4x3m in size and ~1m in height, and most were single units, although in one case seven were conjoined (Figure 5.53), and in another two were combined into a single tomb. The two Wadi Suq tombs were circular, and approximately 4m in diameter. The Honeycomb Tombs were made up of 2, 3, and 5 conjoined ‘chambers’, forming irregular shapes; all were in quite poor condition. The Cell Graves’ chambers are oval and normally between 1.5 and 2m long and half as wide. The ‘chambers’ or voids in the Honeycomb Tombs are more varied. The majority of the Cell Graves were oriented approximately E–W, although some varied by as much as 90°. Almost all of the structures appear to have been built in a single phase, although one site had clearly adapted and remodelled the tombs of a previous Hafit cemetery as well as constructing new Cell Graves amongst these tombs.

Table 5.9: Suspected LPT sites recorded during ground-truthing

Site	Description	Setting
P-03	small group of Hafit tombs later remodelled into a LPT cemetery with new tombs added and the originals adapted; angular bedrock pieces and smaller stones; Late Islamic redware	tall ophiolite hill
P-06	diverse collection of 100+ LPTs; wadi cobbles and angular bedrock pieces and gravel; no finds	ophiolite and Quaternary terrace overlooking large wadi
P-07	50–60 walled platforms, unknown form and function; wadi cobbles; Late Islamic redware	Quaternary terrace sloping down into gully
P-09	~10 single and multi-chambered LPTs; wadi cobbles, small stones and gravel; red chert	low Quaternary terrace overlooking wadi beds and substantial Aeolian deposits
P-10	25–30 LPTs; wadi cobbles and angular bedrock pieces, small stones and gravel; Late Islamic redware and chocolate-chip	low Quaternary terrace
P-11	10–15 LPTs; angular bedrock pieces and small stones; Iron II coarseware, Bronze Age fineware	medium Quaternary and ophiolite hill overlooking large wadi
P-12	~10 LPTs; wadi cobbles, angular bedrock slabs, gravel; no finds	low Quaternary terrace adjacent to small wadi channel and Tertiary outcrop
P-13	25–30 LPTs; angular bedrock pieces, wadi cobbles and gravel; no finds	low Quaternary terrace and an adjacent, small Tertiary rock outcrop
P-14	~10 LPTs; wadi cobbles and gravel; no finds	medium conglomerate terrace adjacent to a small wadi
P-18	lone LPT, part of a larger cemetery; wadi cobbles, gravel; no finds	low Quaternary terrace
P-19	10–20 LPTs; wadi cobbles and gravel; Late Islamic redware, Iron II pottery, fine red chert, copper furnace lining	low Quaternary terrace overlooking sizeable wadi
P-20	~5 LPTs, part of a cemetery of 100s of others; wadi cobbles and gravel; no finds	medium Quaternary terrace
P-21	~10 LPTs, single and multi-chambered; wadi cobbles and gravel; no finds	very tall conglomerate hill, within a municipal 'Solid Waste Disposal Site'
P-22	~5 LPTs, part of a cemetery of 100s of others; wadi cobbles and gravel; no finds	slope of a medium conglomerate terrace
P-24	20–30 LPTs, part of a large cemetery; angular bedrock slabs and small stones; Turq	medium Hawasina outcrop
P-25	~10 LPTs, single and multi-chambered, part of a large cemetery; wadi cobbles and small pieces of broken cobble; Late Islamic redware and other coarsewares, Turq and Early Islamic glass	very tall Quaternary hill

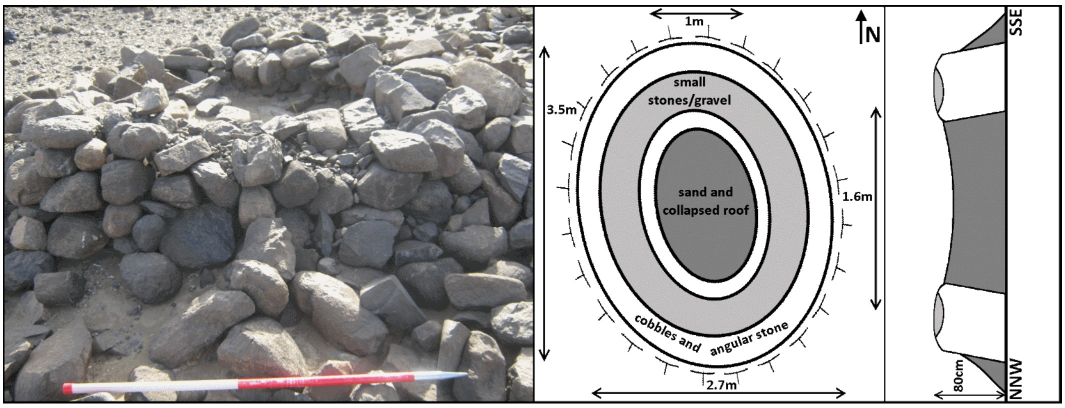


Figure 5.48: P-9-1 — a Cell Grave in quite good condition

These recorded tombs are a representative sample of the suspected Hafits tombs and LPTs classified during the 12" B-GE survey and observed during the ground-truthing fieldwork. These results make it possible to assess the overall accuracy of the final B-GE dataset in terms of distinguishing between Hafit tombs and LPTs (Chapter 4.2.3).

Table 5.10: Characteristics of tombs recorded at suspected LPT sites

Tomb	Type	Condition	Dimensions (m)	Height (m)	Chambers [µ size (m)]	Orientation
P-03-1	Cell Grave?	disturbed	3.8x2.8	1.0	1 [1.9x1.0]	E–W
P-03-2	Hafit to Cell Grave	quite well preserved	6.4x4.2	1.5	1 [1.1x0.8]	N–S
P-06-1	Wadi Suq	very well preserved	4.3x4.3	0.9	1 [–]	NNE–SSW
P-06-2	Wadi Suq	quite well preserved	3.8x3.7	0.3	1 [2.2x2.0]	–
P-07-1	unknown	disturbed	3.0x3.0	0.3	1 [1.3x1.3]	–
P-09-1	Cell Grave	quite well preserved	3.5x2.7	0.8	1 [1.6x1.0]	SSE–NNW
P-09-2	Cell Grave	quite well preserved	2.9x2.8	0.7	1 [1.2x0.8]	SSE–NNW
P-10-1	Cell Grave	quite well preserved	4.8x3.7	0.8	1 [1.7x1.3]	E–W
P-10-2	Cell Grave	quite well preserved	3.9x2.9	0.7	1 [1.6x1.1]	ESE–WNW
P-11-1	unknown	very badly disturbed	6.8x6.8	0.8	–	none
P-11-2	Cell Grave	quite well preserved	4.6x4.2	0.9	1 [1.9x0.9]	N–S
P-12-1	Cell Grave?	disturbed	4.3x3.8	0.6	1 [1.8x1.2]	ESE–WNW
P-12-2	Cell Grave?	disturbed	4.4x3.5	0.6	1 [2.6x1.1]	ESE–WNW
P-13-1	Honeycomb?	badly disturbed	8.0x7.5	0.7	3 [1.8x1.8]	–
P-13-2	Cell Grave	quite well preserved	3.5x3.0	0.8	1 [1.8x0.9]	ENE–WSW
P-14-1	Cell Grave	quite well preserved	5.1x3.9	0.6	1 [2.2x0.8]	ESE–WNW
P-14-2	Cell Grave	very well preserved	3.8x2.4	1.0	1 [1.5x0.5]	ENE–WSW
P-18-1	Cell Grave	disturbed	5.4x3.5	0.8	2 [1.5x0.7]	ESE–WNW
P-19-1	Cell Grave	well preserved	4.4x2.7	0.8	1 [2.5x0.9]	ESE–WNW
P-19-2	Cell Grave	well preserved	3.7x2.6	0.7	1 [1.7x0.5]	N–S
P-20-1	Honeycomb?	disturbed	7.1x4.6	1.0	2 [2.0x0.8]	NE–SW
P-20-2	Honeycomb?	disturbed	10.8x3.6	1.0	5 [1.8x0.6]	NE–SW
P-21-1	Cell Grave	very well preserved	5.0x3.0	1.4	1 [3.1x0.6]	E–W
P-21-2	Cell Grave	very well preserved	3.7x2.7	1.4	1 [2.0x0.5]	ENE–WSW
P-22-1	Cell Grave	quite well preserved	4.6x3.2	0.8	1 [1.8x0.9]	E–W
P-22-2	Cell Grave	well preserved	4.8x3.2	1.0	1 [1.8x0.8]	ESE–WNW
P-24-1	Cell Grave?	disturbed	3.8x3.7	0.8	1 [1.6x1.6]	–
P-24-2	Cell Grave	well preserved	3.9x2.8	0.9	1 [1.8x0.9]	ESE–WNW
P-25-1	Cell Grave	well preserved	3.9x3.3	0.7	1 [1.9x1.4]	NE–SW
P-25-2	Cell Grave	well preserved	23.5x4.1	1.1	7 [1.7x0.5]	E–W

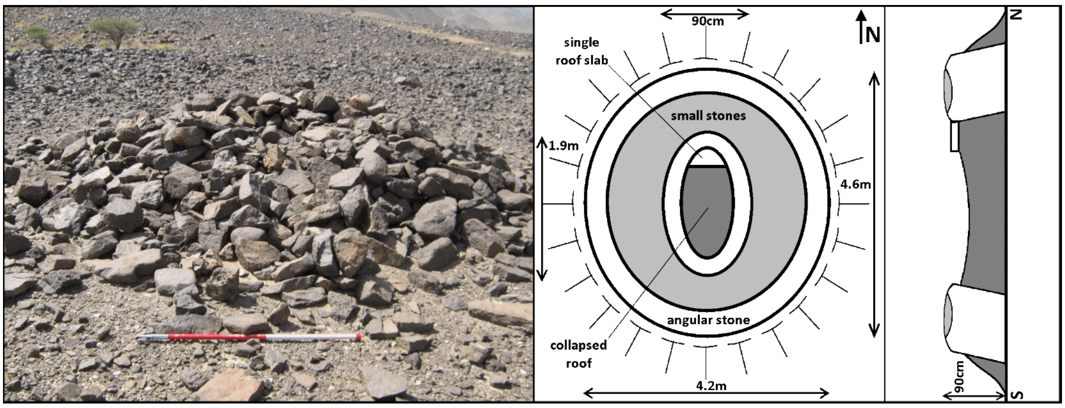


Figure 5.49: P-11-2 — a low Cell Grave in quite good condition

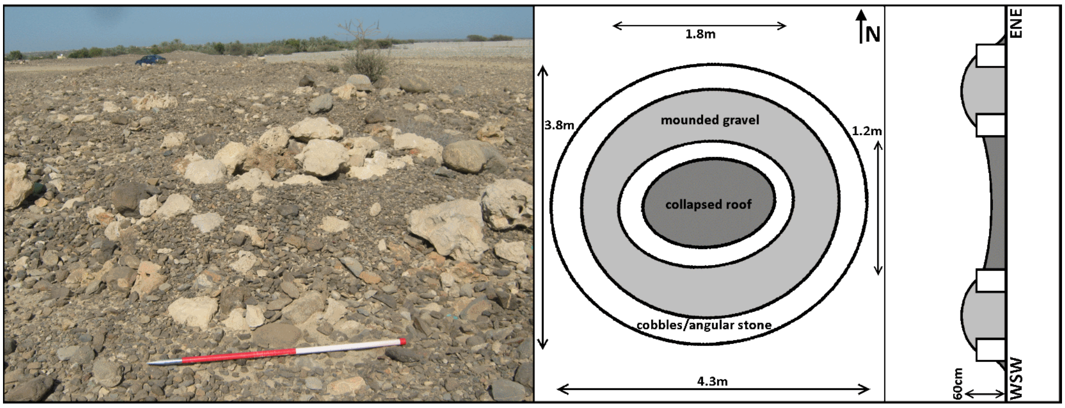


Figure 5.50: P-12-1 — a low Cell Grave in quite good condition, with fine gravel packing

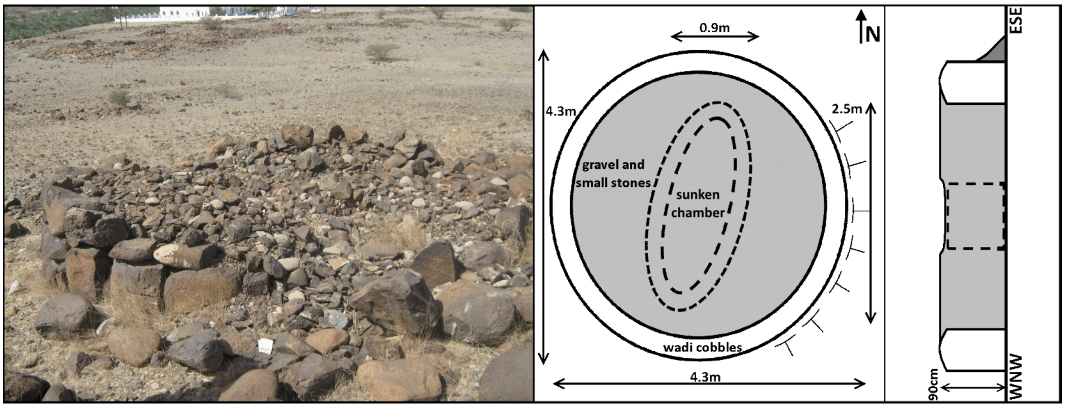


Figure 5.51: P-6-1 — a circular Wadi Suq tomb

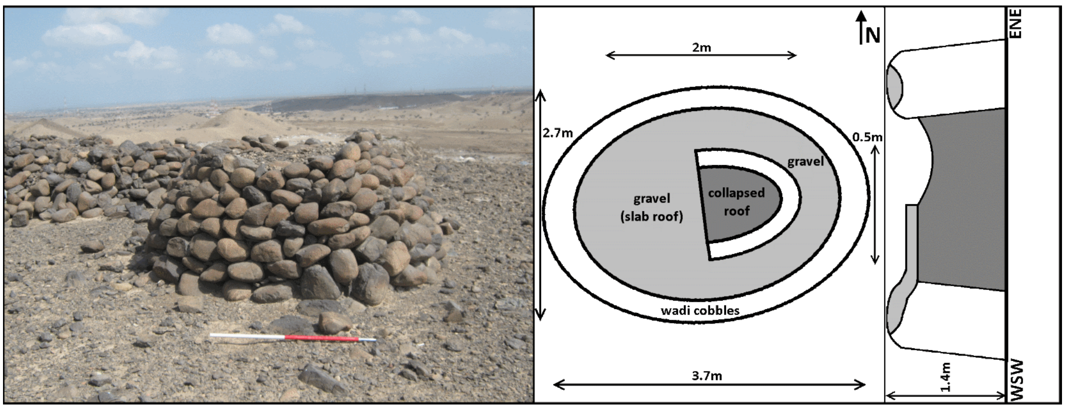


Figure 5.52: P-21-2 — a Cell Grave in almost perfect condition

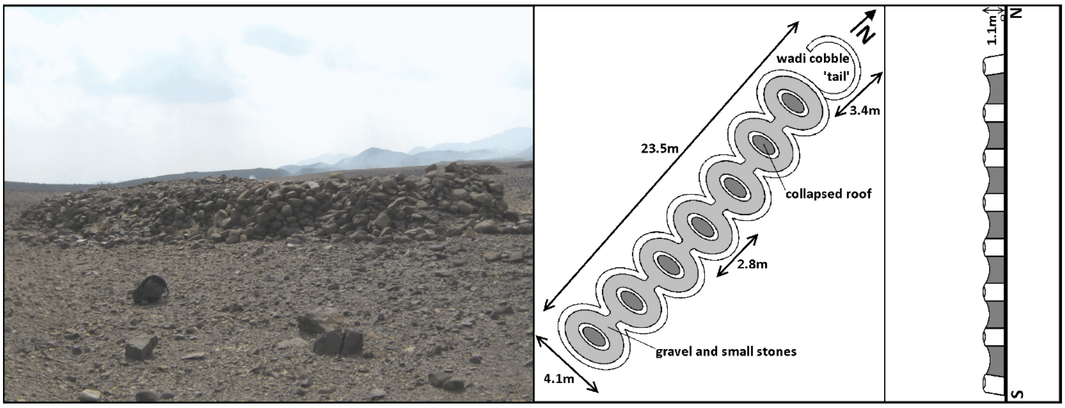


Figure 5.53: P-25-2 — a seven-chambered Cell Grave

5.3.3 Analysis & discussion

The 12" B-GE results were markedly different to those of the 1km grid phase (Table 5.11). During the 1km B-GE survey — when merged with the results of the B-GE transect survey — a total of 10,749 suspected tombs were marked: 7,378 suspected Hafit tombs (69%); and 3,371 LPTs (31%). When these areas were resurveyed 14,888 suspected tombs were located: 6,390 Hafit tomb (43%); and 8,498 LPTs (57%). ~40% more tombs were located using this higher level of magnification, and they were identified in very different proportions with LPTs outnumbering Hafit tombs. The greater level of magnification made it possible to distinguish genuine Hafit tombs from the LPTs that merely resembled Hafit tombs in the satellite imagery. The refinements have greatly improved the accuracy and reliability of the B-GE survey methodology (see 4.2).

Table 5.11: The number of suspected Hafit tombs and LPTs identified during both phases of the final B-GE survey

	Total	Hafit	LPTs
1km B-GE	10,749	7,387 (69%)	3,372 (31%)
12" B-GE	14,888	6,390 (43%)	8,498 (57%)

Tomb distributions are analysed in detail later, but some preliminary observations can be made. As already observed (Chapter 4.3.3), the Hafit tombs are concentrated in a 'Batinah band' running along the lower Quaternary foothills between the mountains and the sea. A very small proportion of the tombs are found in the lower coastal plains or, much more surprisingly, the taller and rockier foothills. Although showing a slightly wider distribution, the LPTs display a very similar pattern. The Hafit tombs and LPTs are found throughout the Batinah, but Hafit tombs are found in greater numbers in the southeast and the LPTs are more numerous in the northwest.

66 tombs were recorded during ground-truthing: 36 classed as Hafit; and 30 as LPTs. No glaring tomb classification errors were made during the 12" B-GE survey: no features marked as Hafit were subsequently identified as Cell Graves or Honeycomb Tombs in the field; neither did any suspected LPTs prove to be Hafit tombs, apart from a single structure that had been completely remodelled as a double Cell Grave (P-03-2). The majority of the Hafit tombs were clearly identifiable in the field and many of the others were classed as 'probable Hafit tombs', being in too poor a condition to be identified with complete certainty (Table 5.12). Even the four 'unknown' tombs were most similar to Hafit tombs, but were so badly preserved that even a probable identification could not be made. The majority of LPTs proved clearly to be Cell Graves in the field, and many of the remaining features were identified as possible Cell Graves due to their inferior condition

(Table 5.12). Three LPTs were identified as possible Honeycomb Tombs, two as circular Wadi Suq tombs, one was completely destroyed and could not be identified, and the last had no known parallels in the literature and could either be a LPT or part of an Islamic domestic site. These results clearly demonstrate that it is possible to reliably distinguish Hafit tombs from LPTs using Google Earth (Chapter 4.2); the only difficulties arise when Hafit tombs are remodelled and adapted for use in later periods (e.g. P-03 and H-19).

Table 5.12: Ground-truthing results — the identification of suspected Hafits tombs and LPTs

	Hafit	LPTs
Hafit	19	0
Hafit?	13	0
Hafit/Cell Grave	0	1
Cell Grave	0	18
Cell Grave?	0	4
Honeycomb Tomb?	0	3
Wadi Suq	0	2
unknown	4	2
Total	36	30

Hafit tomb Google Earth survey reliability is discussed in much greater detail elsewhere (Chapter 4.2), and while these results provide clear evidence that it is possible to reliably distinguish Hafit tombs from LPTs the process is not completely reliable and this needs to be borne in mind when analysing and drawing conclusions from the B-GE tomb datasets. It is certainly worth comparing and contrasting the distribution of the Hafit tombs and LPTs to shed light on Batinah Hafit occupation, and this will be carried out in the next main section.

The ground-truthing fieldwork data also reveals much about the Batinah's Hafit tombs and LPTs. The majority of all tombs are located on Quaternary fluvial material — the conglomerate and gravel hills of the bajada outwash zone (72% of Hafit tombs and 77% of LPTs), the rest are found on the rocky hills and ridges of Tertiary, Cretaceous and older ophiolite and Hawasina material (Table 5.13). Despite the small total surface area just over 11% of the Hafit tombs are located on Tertiary hills and ridges, compared to only 3% of LPTs. Reflecting the local geology, the majority of tombs were built with wadi cobbles (56% of Hafit tombs and 60% of LPTs), with a smaller proportion being constructed from angular bedrock pieces or slabs (Hafit 19%, LPTs 23%), and a similar number utilising a combination of both materials (Hafit 25%, LPTs 17%).

Generally, Hafit tombs were found in poorer condition than LPTs (Table 5.14). As expected, all of the Hafit tombs had only one chamber, while although the vast majority of the Cell Graves were single-chambered, a double and a seven-chambered tomb were

Table 5.13: The local geology of recorded Hafit tombs and LPTs

	Hafit	LPTs	Batinah
Quaternary	26 (72.2%)	23 (76.7%)	~42%
Tertiary	4 (11.1%)	1 (3.3%)	~1%
Cretaceous shelf	2 (5.6%)	0 (0%)	~1%
Hawasina	0 (0%)	2 (6.7%)	~7%
Ophiolite	4 (11.1%)	4 (13.3%)	~38%
Hajar Limestone	0	0	~12%
Total	36	30	

also recorded. The three probable Honeycomb Tombs were all multi-chambered (2, 3 and 5 chambers), while the two circular Wadi Suq tombs both appear to have only one chamber. Evidence for side entrances was only observed in two of the Hafit tombs: H-19-1 has a well-preserved, triangular, corbelled entrance in its northwestern side, and H-21-2 has a similar entrance in its southeastern side. None of the other tombs, including some of the almost perfectly preserved Cell Graves, showed evidence of having side entrances. It is most likely that they were accessed through a hole in the roof, were constructed over the deceased, or interments were made partway through tomb construction.

Table 5.14: The condition of the recorded Hafit tombs and LPTs

	Hafit	LPTs
very well preserved	5 (13.9%)	4 (13.3%)
well preserved	1 (2.8%)	6 (20%)
quite well preserved	6 (16.7%)	10 (33.3%)
disturbed	12 (33.3%)	8 (26.7%)
badly disturbed	9 (25%)	1 (3.3%)
very badly disturbed	3 (8.3%)	1 (3.3%)
Total	36	30

Comparing the two most numerous tombs types — Hafit tombs and single-chambered Cell Graves — the former are larger on average, with mean dimensions of 5.1x4.9m, and are circular or sub-circular in shape while Cell Graves are generally smaller, a mean of 4.1x3.1m, and are oval with a mean aspect ratio of 1:1.3. Hafit tomb chambers are larger than the Cell Graves' and are circular in shape rather than oval (Table 5.15)[6]. The possible Honeycomb Tombs vary in shape and size from sub-circular (8x7.5m) to oval (7.1x4.6m and 10.8x3.6m), with aspect ratios of 1:1.07, 1:1.54 and 1:3. Compared to the more numerous types, the chambers of the Honeycomb Tombs are much more irregular in

[6]these statistics are only calculated from single-chambered Cell Graves, the individual parts of the multiple-chambered structures are very similar in shape and size

shape and vary in size. The two Wadi Suq tombs are circular (4.3x4.3m) and sub-circular (3.8x3.7m); it is not possible to measure the size of their chambers as they are fully or partially buried either under gravel or the ground surface.

Table 5.15: The dimensions and aspect ratios of the structure and chambers of the recorded Hafit tombs and single-chambered Cell Graves

	length (m)		width (m)		aspect ratio	
	range	mean	range	mean	range	mean
Hafit tombs	2.6–8.7	5.1	2.5–8.5	4.9	1.00–1.17	1.04
Cell Graves	2.9–5.1	4.1	2.8–3.9	3.1	1.03–1.67	1.33
HT chambers	1.4–2.5	2.1	1.2–2.3	2.0	1.00–1.17	1.08
CG chambers	1.2–3.1	1.9	0.5–1.6	0.9	1.00–5.20	2.30

The Hafit tombs are generally significantly taller than the LPTs: Hafit tombs range in height from 0.4–2.5m; Cell Graves from 0.6–1.4m; Honeycomb Tombs from 0.7–1m; and the circular Wadi Suq graves from 0.3–0.9m. Taking the condition of tombs into account, the mean height of a 'very well preserved' or 'well preserved' Hafit tomb is 1.83m, compared to 1m for Cell Graves in similar condition.

As Hafit tomb are circular it is meaningless to comment on their orientation. Similarly, the Honeycomb Tombs, and their chambers, are so irregular in shape that they are not clearly oriented in any direction. However, the vast majority of the Cell Graves are oval or sub-circular in form and have a similarly shaped chamber and therefore an orientation. Of the 21 possible and confirmed Cell Graves, the vast majority are aligned approximately E-W (16/21, 76%), i.e. between ENE-WSW and ESE-WSW. One Cell Grave points NE-SW, two point N-S and a further two are oriented SSE-NNW. While the chamber of one of the circular Wadi Suq tombs is not visible, the other — sunken into the gravel and small stones — is aligned NNE-SSW.

All but one of the tombs that were altered in later periods were originally Hafit tombs. P-11-1 may originally have been a Cell Grave, based on the surrounding structures, but the tomb was completely deconstructed and possibly rebuilt as a sangar overlooking a valley to protect an Islamic settlement. P-03-2 was originally a Hafit tombs but was remodelled as a Cell Grave with an extra chamber added to the side of the structure. H-22-2 appears to have been remodelled as a Honeycomb Tomb with three chambers being added into the collapsed or purposefully deconstructed masonry filling the original central, circular chamber. The masonry from H-17-2 was reformed into a 'long-barrow shape' on the original tomb platform. H-24-1 was altered much more recently — collapsed masonry was used to build a survey cairn on one side of the tomb.

Surface finds were observed at just over a third of the tombs: 14 of the 36 Hafit tombs and 11 of the 30 LPTs (Table 5.16). The vast majority of surface finds noted in the vicinity of Hafit tombs were pieces of red, grey or caramel chert observed at eleven of the tombs, but none were clearly anthropogenic and they could well date to an earlier period. Sherds of coarse Islamic redware were found in the vicinity of six Hafit tombs, and a further structure yielded sherds of modern porcelain. Chert was much less common around the LPTs, and was found at only three Cell Graves. Late Islamic pottery — including sherds of chocolate-chip and various redwares — were found in the vicinity of seven Cell Graves and the enigmatic oblong structure. Samad/Sasanian/Early Islamic blue-green Turquoise glazed pottery (AKA Turq) was found at two Cell Graves, one of which also yielded fragments of Early Islamic blue glass. Coarse Iron Age II pottery — red with vegetable temper and chevron decoration — was observed in the vicinity of three Cell Graves, one of these also yielded a fine orange pottery with a red slip that probably dates to the third or second millennium BC. Copper furnace lining fragments were found in the vicinity of the two Cell Graves at site P-19. These surface finds are of limited use in dating the tombs — the vast majority consist of either Late Islamic pottery or possibly natural chert — the pottery is undoubtedly the result of depositions dating from long after the construction of the tombs, and even if the chert is anthropogenic it cannot be used to date the sites. What little earlier pottery there is was observed around a relatively small number of Cell Graves, and unhelpfully dates from the Bronze Age to the Early Islamic period.

Table 5.16: The number of Hafit tombs and LPTs with surface finds observed during fieldwork

	Hafit	LPT
no finds	22 (61%)	19 (63%)
chert	11 (31%)	3 (10%)
20th century pottery	1 (3%)	
Late Islamic pottery	6 (17%)	8 (27%)
Early Islamic glass		1 (3%)
Samad/Sasanian/Early Islamic pottery		2 (7%)
Iron Age II pottery		3 (10%)
Bronze Age pottery		1 (3%)
copper furnace lining		2 (7%)

This two-phased B-GE survey has generated a distribution map of Hafit tombs in the Batinah. Ground-truthing fieldwork adds considerable weight to the argument that it is possible to accurately distinguish Hafit tombs from LPTs (Chapter 4.2). Mapping the location of thousands of LPTs is a bonus that, along with the tombs recorded in the field, greatly advances our knowledge of later tombs in the region.

The B-GE results may also usefully be compared to those of the NOP-GE survey in order to gauge the accuracy of this earlier research, specifically attempts to quantify the survey. By multiplying the mean number of tombs that were found in each level of survey square (Chapter 4.4.2) by the corrected number of the squares of each level in the Batinah, allowing for partial squares on the coast and between regions and the small number of U squares, and adding these figures together it was possible to reach an estimate of the number of tombs expected to be visible in Batinah satellite imagery of 4,756.49. This is only 25.6% smaller than the B-GE figure of 6,390 — a good agreement given the significant variation in the number of tombs observed between levels in the NOP-GE quantification survey. By applying the number of Hafit tombs recorded during the B-GE survey to Ubelaker's formula (Chapter 4.4.2), a Hafit population estimate for the Batinah is reached of between 1,362 and 3,431. As with the original NOP-GE attempt, this is a very rough, somewhat speculative estimate designed only to give some general indication of the size of the population. The estimate yields an overall population density figure of between 0.11 and 0.27 people/sq-km, very slightly lower than that calculated for the northern Oman Peninsula study area as a whole (Chapter 4.4.2). Overall, given the roughness of the methodology, the B-GE results are consistent with the findings of the NOP-GE survey.

5.4 GIS analysis

The Hafit tomb and LPT datasets will now be analysed in order to shed light on the nature of Hafit society in this region of the northern Oman Peninsula. The aim is to model the distribution of the Hafit tombs in their landscape, and to establish how Batinah Hafit tomb distribution and human occupation patterns compare to elsewhere in the northern Oman Peninsula. A variety of environmental and anthropogenic variables will be analysed, providing data that will begin to answer the most basic questions as to where and how the Hafit population lived in this region.

The LPT dataset will also be analysed to provide a comparison. There are issues with this approach — the dataset consists of various tomb types, the chronology and typological relationship between which are not yet understood. However, the vast majority of the tombs are Cell Graves and many of the others are Honeycomb Tombs, both of these types appear to date to some point in the Iron Age (Chapter 4.2.1), and by definition the other LPTs must date from after the Early Bronze Age, postdating the introduction of sedentary agriculture into the northern Oman Peninsula. Whether the LPT builders were sedentary farmers or pastoralists codependent on agricultural communities located elsewhere in the Batinah, they are likely to have occupied the landscape in a way fundamentally different from independent pastoralists. Therefore, the LPT dataset should provide a useful comparison to the Hafit tomb analysis, as there is currently little agreement regarding Hafit subsistence (Chapter 2).

Before carrying out complex, quantitative GIS analyses, the distribution of Hafit tombs and LPTs will be examined qualitatively. Simple observations of the tombs and their environment will be made, drawing out broad patterns that can be tested with GIS analysis. The distribution of both tomb types will be examined against a **basemap** of satellite imagery and a digital elevation model (DEM). The two datasets will then be subjected to GIS analysis: firstly of the spatial relationship between the tombs; and then of the distribution of the tombs within their natural and anthropogenic environment. The results will be interpreted, drawing out what they reveal about the nature of Hafit society in the Batinah. A cautionary note must be expressed regarding the GIS analysis, as although there is a good case for the reliability of the Google Earth methodology in distinguishing Hafit tombs and LPTs, it would be naive to argue that this process is perfect (Chapter 4.2) — conclusions about Hafit period occupation drawn from this data analysis should therefore be tempered with due caution.

5.4.1 Qualitative observations

Qualitative examination reveals three main levels of grouping in Hafit tombs. Clusters, usually of between one and five tombs, are found within a relatively short distance of one another (5–100m); very large numbers of Clusters form Necropolises — groups of tombs that share a single ridge or a small range of hills; and several Necropolises form Agglomerations — large, but discrete groups of tombs that stretch over kilometres (Figure 5.54). LPTs show a different pattern: Clusters contain many more tombs, and form fewer Necropolises and Agglomerations with greater distances between them. Hafit tombs are distributed more sparsely over larger areas, while LPTs form denser, more discrete groups. In terms of their regional distribution, Hafit tombs are found in greater numbers in the southeastern half of the Batinah, while LPTs are more numerous in the northwest.

LPTs clearly have a relationship with Hafit tombs. LPT cemeteries often overlap slightly with Hafit cemeteries, and may even have 'taken over' space that originally contained Hafit tombs (Figure 5.55). During fieldwork it was repeatedly observed that Hafit tombs were found in close proximity to LPTs and usually were in much worse condition, and may even have been used as a source of building material; in some cases the Hafit tombs were remodelled and adapted to resemble Cell Graves and Honeycomb Tombs.

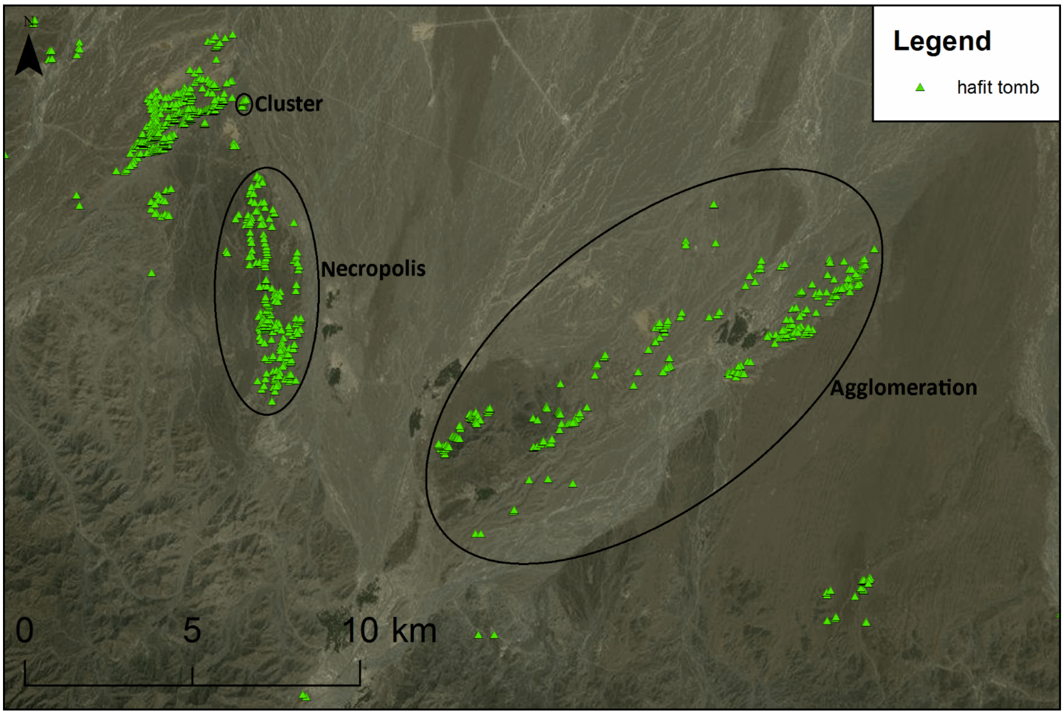


Figure 5.54: An example of the three levels of Hafit tomb groupings

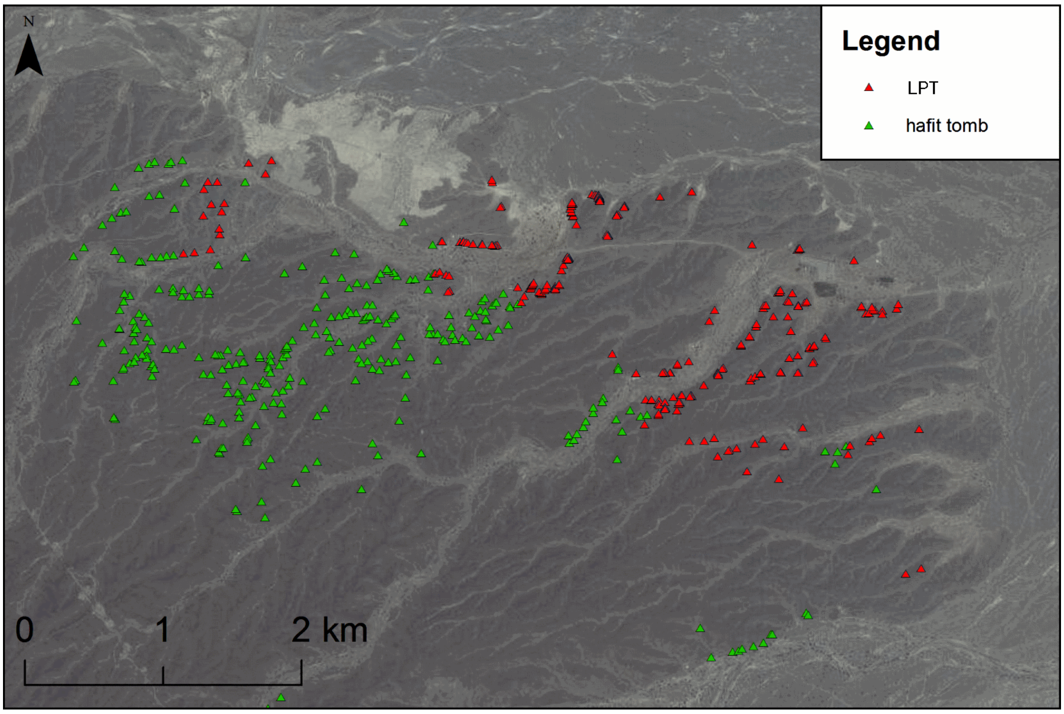


Figure 5.55: Overlapping areas occupied by Hafit tombs and LPTs

The vast majority of Hafit tombs are found at a low/medium elevation: none were observed at sea level or near the coast, and very few are found in the coastal plain; only a small number penetrate very deeply into the Hajar Mountains and the ophiolite foothills (Figure 5.56). These upland tombs are located in lower-lying areas, where erosion has gouged out wadi valleys and bowls. Topographically the Hafit tombs' favoured area corresponds to the low hills of the bajada outwash zone, where wadis emerge from the rocky foothills onto the coastal plain. LPTs show a similar, but slightly wider distribution, stretching further into the lower parts of the plain towards the coast, and the rocky foothills of the Hajar Mountains.

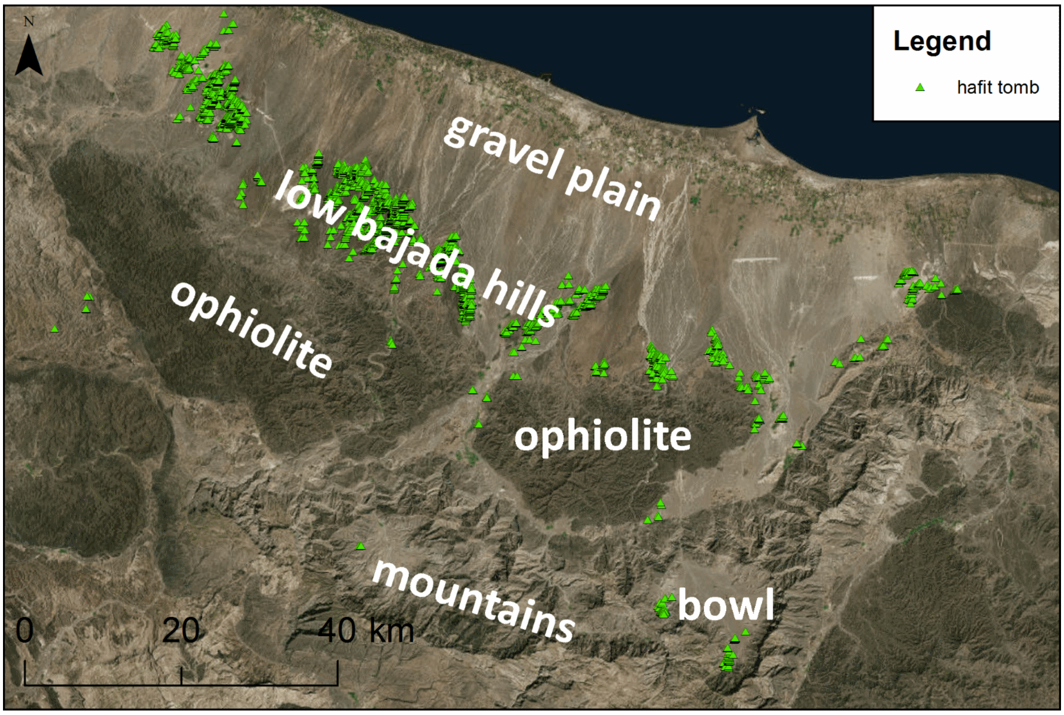


Figure 5.56: Hafit tomb preference for the low bajada hills

Hafit tombs are frequently found in close proximity to wadi channels — ranging in size from small streams to large river beds — usually where they cut through the low bajada hills, before they sink into the gravels of the flat coastal plain. The tombs often run along available higher ground adjacent to wadi channels and beds, but they also spread out over the low hills that lie between wadis (Figure 5.57). Some sizeable channels lack Hafit tombs or boast only very few, while some small channels support a disproportionately large number of tombs. In the northwestern half of the Batinah the coastal plain shortens and the number of Hafit tombs drops, and they retreat towards the rocky foothills where the wadi channels are narrow. LPTs show a similar distribution pattern, but they show much more of a preference for areas further downstream, towards the coastal plain, or further upstream, in the rocky foothills. They are much less likely to stretch out between wadi channels compared to Hafit tombs, rather they tend to congregate at a low or moderate distance from them.

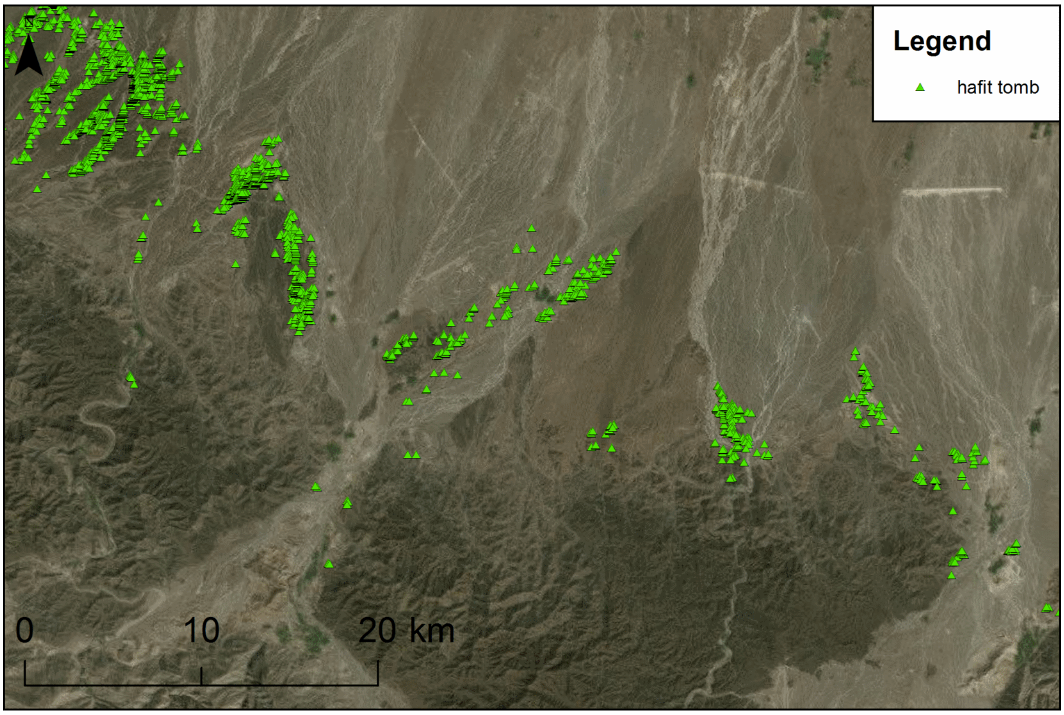


Figure 5.57: Hafit tombs clustered alongside wadi channels of the bajada and foothills

Although no Hafit tombs occur on the flat coastal gravel plain, the vast majority are located in the low bajada hills that overlook it. Despite their overall tiny surface area, many tombs are located on or near to ridges of pale, buff Tertiary limestone that outcrop within the bajada (Figure 5.58). A much smaller number of tombs are found in the rocky foothills of the Hajar Mountains, some on the Cretaceous limestone shelf, basin facies and Hawasina deposits, and a very small number right on the edge of the large ophiolite hill fields, with none at the centre of these deposits. A small number of Hafit tombs are found on the older limestone of the Hajar Mountains. The LPT geological distribution is similar, but a greater proportion are located on ophiolite, and fewer on the Tertiary material — the majority of tombs are found in the northwestern Batinah where these outcrops are few or absent.

Hafit tombs favour an area that has barely been inhabited since (Kennet, al-Jahwari, Deadman, Brown, et al. 2016). Modern agricultural settlements centre on the coastal plain, up to ~5km from the sea, with the vast majority of villages and farms being located here; a smaller number hug major wadis running through the rocky foothills and mountains, and to a lesser extent, the foothills-bajada interface. In contrast, the majority of Hafit tombs congregate between these two areas in the low bajada hills (Figure 5.59). While this area was clearly significant during the Hafit period, the lack of Hafit tombs surrounding the large wadis in the upland and rocky foothill areas — where water is readily available and easy to control — is puzzling. LPTs show a similar but weaker

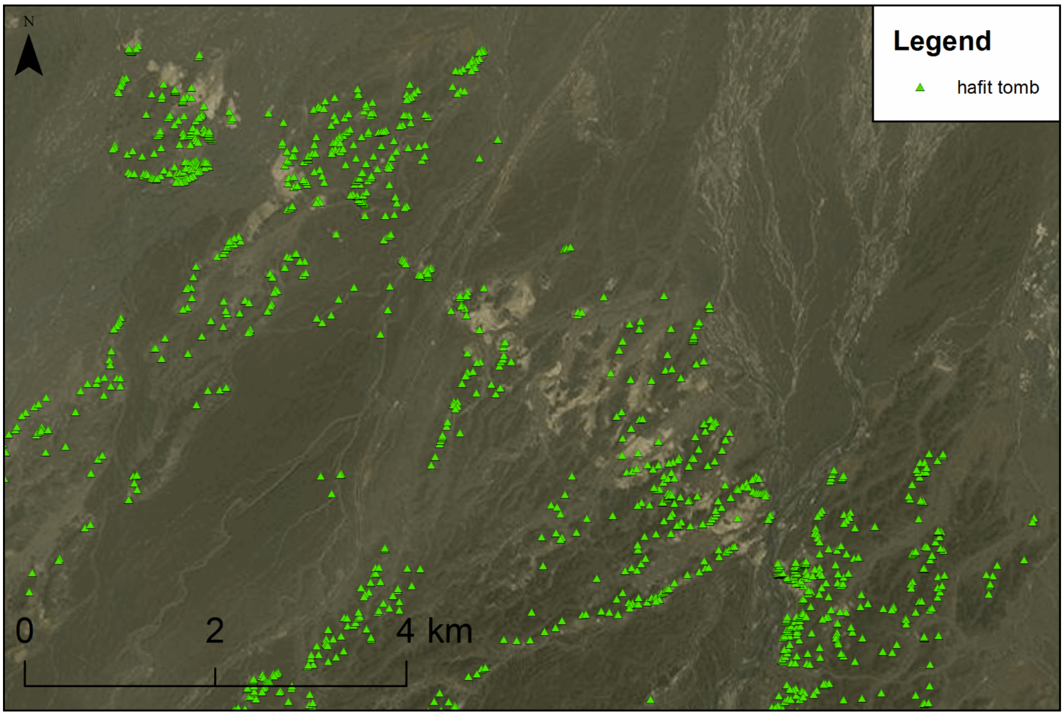


Figure 5.58: Hafit tombs concentrated around pale buff Tertiary rock outcrops

pattern —- they prefer the bajada hills that lie closest to the coastal plain and the sea, and are found in much greater numbers in the rocky foothills and at the foothill/bajada interface where there is some modern settlement.

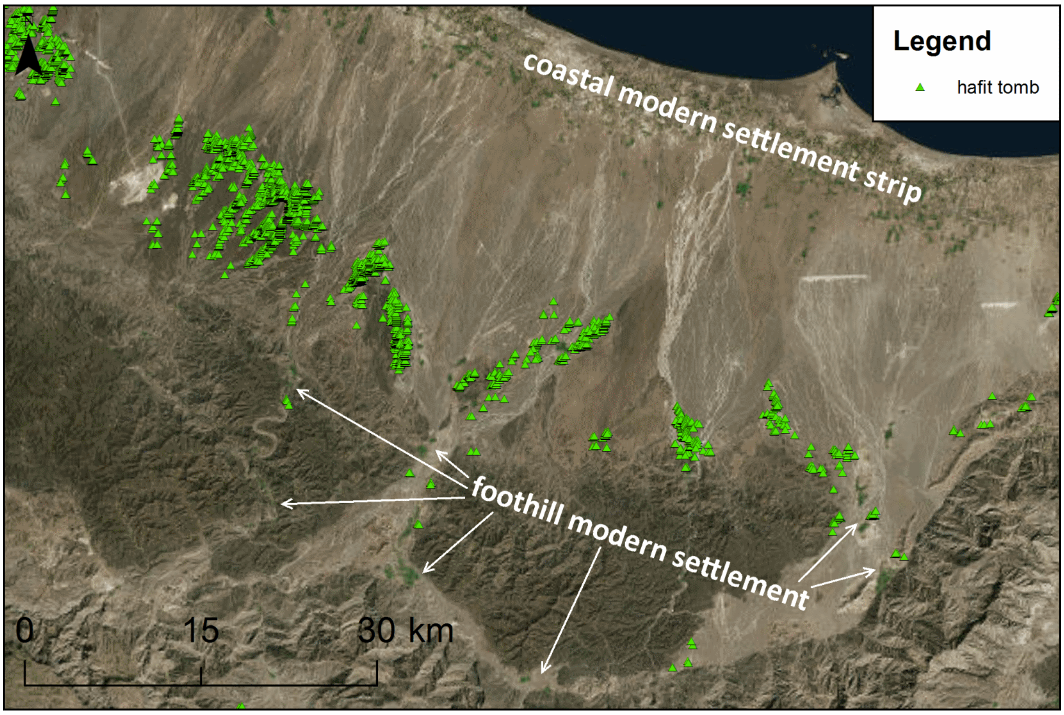


Figure 5.59: Hafit tombs concentrated in area between modern settlements in the foothills and the dense coastal strip

These broad patterns in Hafit tomb and LPT distribution may now be tested and refined through GIS analysis.

5.4.2 Method

Two aspects of Hafit tomb and LPT distribution will be examined: how the tombs relate to their environment; and how the tombs relate to each other. The GIS analysis of the two funerary datasets is divided into two parts. 'Spatial distribution' examines the spatial relationship between the tombs, in particular how the tombs form groups and relate over various distances. 'Environmental distribution' examines the position of the tombs within their local environment — modelling the distribution of the tombs through a diverse set of environmental and anthropogenic variables.

The methods employed in both sets of analysis are described below. **ArcGIS** 10.2 was used to conduct the GIS analysis; the results were imported into Microsoft Excel for data analysis.

Spatial distribution

Qualitative observation of Hafit tomb and LPT distribution suggests that tombs form groups at three levels: small groups with tombs up to 100m apart; bigger groupings with tombs up to a kilometre apart; and very large groups with tombs up to several kilometres apart. The following GIS analyses will test these observations and compare the spatial distribution of Hafit tombs and LPTs.

Firstly, a tomb density map — over a 1km distance — was generated for both datasets, and the results were exported to Excel for statistical and graphical analysis[7].

The spatial relationship between tombs was investigated up to a distance of 4km. The distance between every tomb and each of its neighbours of the same type was measured up to 4,000m[8]. This data was then exported to Excel, and three histograms — with bins at ten evenly-divided intervals — were generated, counting the number of tomb-tomb relationships at short range (up to 100m), medium range (up to 1000m) and long range (up to 4km) for both datasets.

The three grouping levels were formally defined. Tombs up to 100m apart form 'Clusters': not every structure within a Cluster is required to be within 100m of every other, but each must be within 100m of at least one neighbour. Multiple Clusters form 'Necropolises', in which nearest neighbouring tombs are up to 1km apart. Finally,

[7]the **Point Density Tool** was used at a 1km radius, separately on the Hafit and LPT datasets; the **Raster Calculator Tool** was used to remove zero values, and to round the values to a single decimal place; the two raster **attribute tables** were exported to Excel

[8]the **Generate Near Table Tool** was used

Necropolises group to form 'Agglomerations' in which nearest neighbouring tombs are up to 4km apart (Figure 5.60). These distances form the upper limit for each grouping (100m, 1km, 4km) — in the majority of cases neighbouring tombs in these groups will be much closer, with only a small minority of the tombs located at such distances.

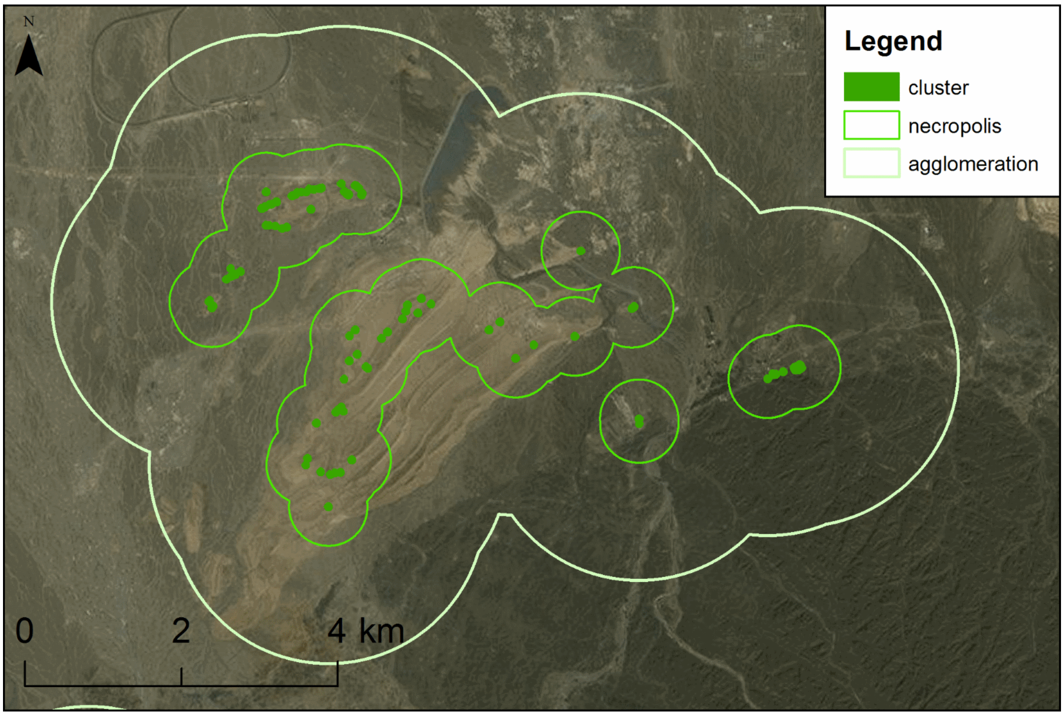


Figure 5.60: An example of Hafit tombs grouped in Clusters, Necropolises and Agglomerations

Polygons were generated to create precise boundaries for the Hafit and LPT Clusters, Necropolises and Agglomerations[9]. The characteristics of each grouping was then examined: surface area; the number of tombs; tomb density; the number of Clusters within each Necropolis and Agglomeration; and the number of Necropolises within each Agglomeration[10].

The spatial relationships between individual tombs and tomb groupings were also investigated. Within tomb groups a distinction is made between neighbouring tombs and near-neighbouring tombs. A tomb's neighbours consist of all others in the same group regardless of distance, while near-neighbours are the subset that link a tomb to the group (Figure 5.61) — i.e. those that are within 100m, 1000m, or 4000m in a Cluster,

[9]the **Buffer Tool** was used separately on the Hafit tomb and LPT datasets, at half the distance of each respective grouping (50m, 500m, 2km) with the 'dissolve' setting set to ALL; the **Multipart To Singlepart Tool** was then used on both outputs to create individual polygons

[10]surface area was calculated using the **Calculate Geometry** menu option from the **attribute tables**; the number of tombs or groupings within Clusters, Necropolises and Agglomerations was counted using the **Join** feature menu option; and density was calculated within attribute tables using the **Field Calculator** (tomb count/surface area)

Necropolis or Agglomeration[11]. The distance between every tomb and its neighbours and near-neighbours was measured and the spatial relationships within each group was statistically analysed. Every tomb's neighbours and near neighbours were counted, as well as the maximum, minimum and mean distances to them[12].

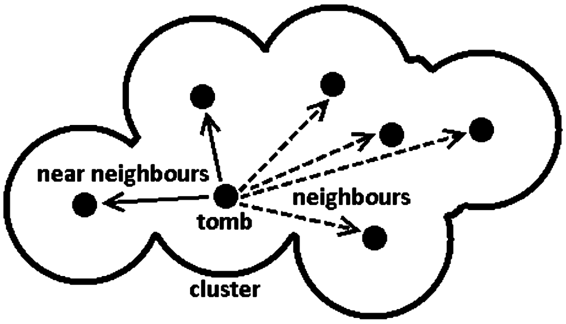


Figure 5.61: Schematic explanation of the difference between 'neighbours' and 'near neighbours'

The spatial relationship between Hafits tombs and LPTs was also examined. Three analyses were carried out: distance from LPTs to the nearest Hafit tomb; Hafit tomb count within LPT Clusters, Necropolises and Agglomerations; Hafit tomb count from LPTs to a range of distances between 100m and 4km[13]. The results were imported into Excel for statistical and graphical analysis.

Environmental distribution

The distribution of the Hafit tombs and LPTs within their environment was also analysed. The same basic method was applied to eleven variables that fall under four general categories: elevation and topography; hydrology; geology; and modern settlement. Data was sourced or generated for each variable, covering the precise geographical extent of the Batinah, thereby providing a landscape control, and values for

[11]while running the neighbour analyses for the Clusters and Necropolises, the distance between the grouping and the tombs within was taken into account, so that the distance between tombs themselves within the two groupings was measured, so the analyses were run at 900m (1km–100m) and 3km (4km–1km) respectively

[12]the **Generate Near Table Tool** was used with an **Iterator Feature Selection** used to loop through every Cluster, Necropolis or Agglomeration ID in the tomb **attribute table**; this was repeated a second time for each grouping with the **Generate Near Table Tool** set to the relevant distance for either a Cluster (100m), Necropolis (1000m) or Agglomeration (4000m) to include only near-neighbouring tombs

[13]the **Near Tool** was used for the first analysis; the **Spatial Join Tool** was used for the second; and the **Spatial Join Tool** was used in conjunction with a **For Iterator** and a list of the values to be analysed in the final analysis

each Hafit tomb and LPT were extracted, before all three were statistically analysed (Figure 5.62)[14]. Descriptive statistics were calculated and histograms were generated in Excel.

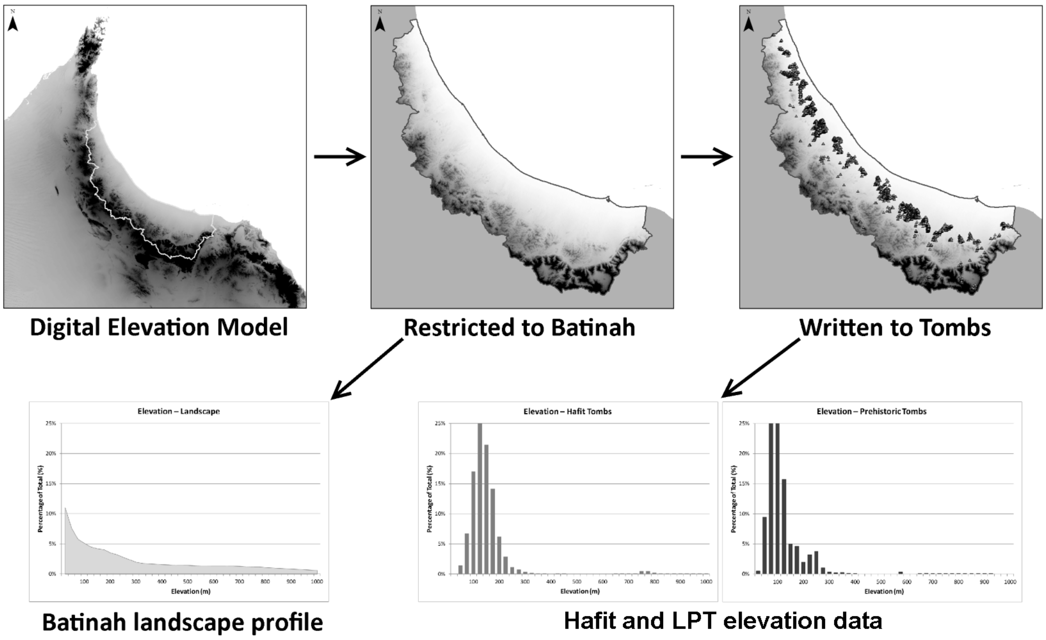


Figure 5.62: The general method of Batinah landscape and tomb analysis

The variables analysed to model the environmental and anthropogenic distribution of the Hafit tombs and LPTs are summarised (Table 5.17), and described in greater detail below.

Elevation and topography: A clear pattern in the distribution of Hafit tombs was observed during qualitative evaluation. The vast majority of the tombs are at a low-medium elevation in the low bajada hills: none were found at sea level near to the coast, and very few in the flatter parts of the plain; the few that were found at higher elevations in the Hajar Mountains were located in valleys and bowls rather than the mountain uplands. A similar pattern was observed for the LPTs, but they were distributed slightly more widely than the Hafit tombs. These observations were tested through the analysis of four variables: ‘elevation’; ‘elevation range’; ‘Topographic Position Index’ (TPI); and ‘distance to coast’.

These variables allow the topographical distribution of the tombs to be defined (Figure 5.63). Examining ‘elevation’ will demonstrate which zones were preferred by the Hafit and the later population(s). Analysing ‘elevation range’ establishes the topographical

[14]each variable analysed had an individual ArcGIS **raster** clipped to the shape of the Batinah using the **Clip Tool** and an ArcGIS polygon **shapefile** of the Batinah borders; values for each Hafit tomb and LPT were taken from each raster using the **Extract Values to Points Tool**; the **attribute tables** of the tomb **shapefiles** with a field for each variable and the variable raster histograms were exported to Excel

Table 5.17: Environmental and anthropogenic variables analysed to model the distribution of Hafit tombs and LPTs in the landscape

Category	Variable	Description
Elevation & Topography	Elevation	Elevation in metres
	Elevation range	Range in elevation in local area (within 1km)
	Topographic Position Index	A measure of the elevation of each raster pixel within the context of its surroundings
	Distance to Coast	Distance to the coast
Hydrology	Distance to wadi	Distance to nearest wadi channel
	Drainage area of largest wadi	Drainage area of the largest wadi channel in the local area (within 1km)
Geology	Distance to Tertiary ridge	Distance to the linear formation of Tertiary material
	Tertiary ridge zone	Whether in the immediate area (500m) of the Tertiary ridge, towards the sea, or towards the interior
	Distance to copper ore	Distance to known sources of copper ore
Modern Settlement	Distance to modern settlement	Distance to nearest recent settlements from the 1980s
	Density of modern settlement	Number of 1980s settlements within a 5km radius

areas in which the tombs are situated. 'TPI' is a measure of the topographical position of a point within its surroundings — it compares elevation to the mean elevation of the local neighbourhood, with positive values representing locations that are higher than average compared to their surroundings (hills and ridges), negative values locations that are lower than their surroundings (the foot of hills and valleys), and values near zero represent flat areas or areas of constant slope (Weiss 2001). 'Distance to coast' will quantify the spatial relationship between tombs and the marine environment.

Other than 'distance to coast', each of these variables is based upon the same data — the ASTER-2 Global Digital Elevation Model, a 30m resolution dataset based on satellite radiometric data (Japan Space Systems 2011). For 'elevation' the original **digital elevation model** was used. The 'elevation range' dataset was generated by setting ArcGIS to find the highest and lowest elevation value within a 1km radius of every pixel in the dataset, subtracting these values and writing the results to a new dataset[15]. The published TPI300 method was used to generate a 'Topographic Position Index' dataset for the Batinah (Weiss 2001) — this calculates the difference between each individual pixel of the digital elevation model and the mean elevation of the surrounding area within a ring of 300 and 150m radii, writing the results to a new dataset[16]. Finally, the 'distance to the coast' Batinah dataset was generated based on a freely available **NaturalEarth** 1:10m scale footprint of the ocean (www.naturalearthdata.com)[17]. Each of these datasets were trimmed to exclude areas

[15]the **Focal Statistics Tool** was utilised on the the ASTER DEM, with the circular option selected, and a 1km radius stipulated

[16]the **Focal Statistics Tool** was used, employing the annulus option at 300/150m radii; the **Raster Calculator Tool** was used to generate the final dataset (Int(Elevation – Mean Neighbourhood Elevation) + 0.5)

[17]the **Euclidean Distance Tool** was used

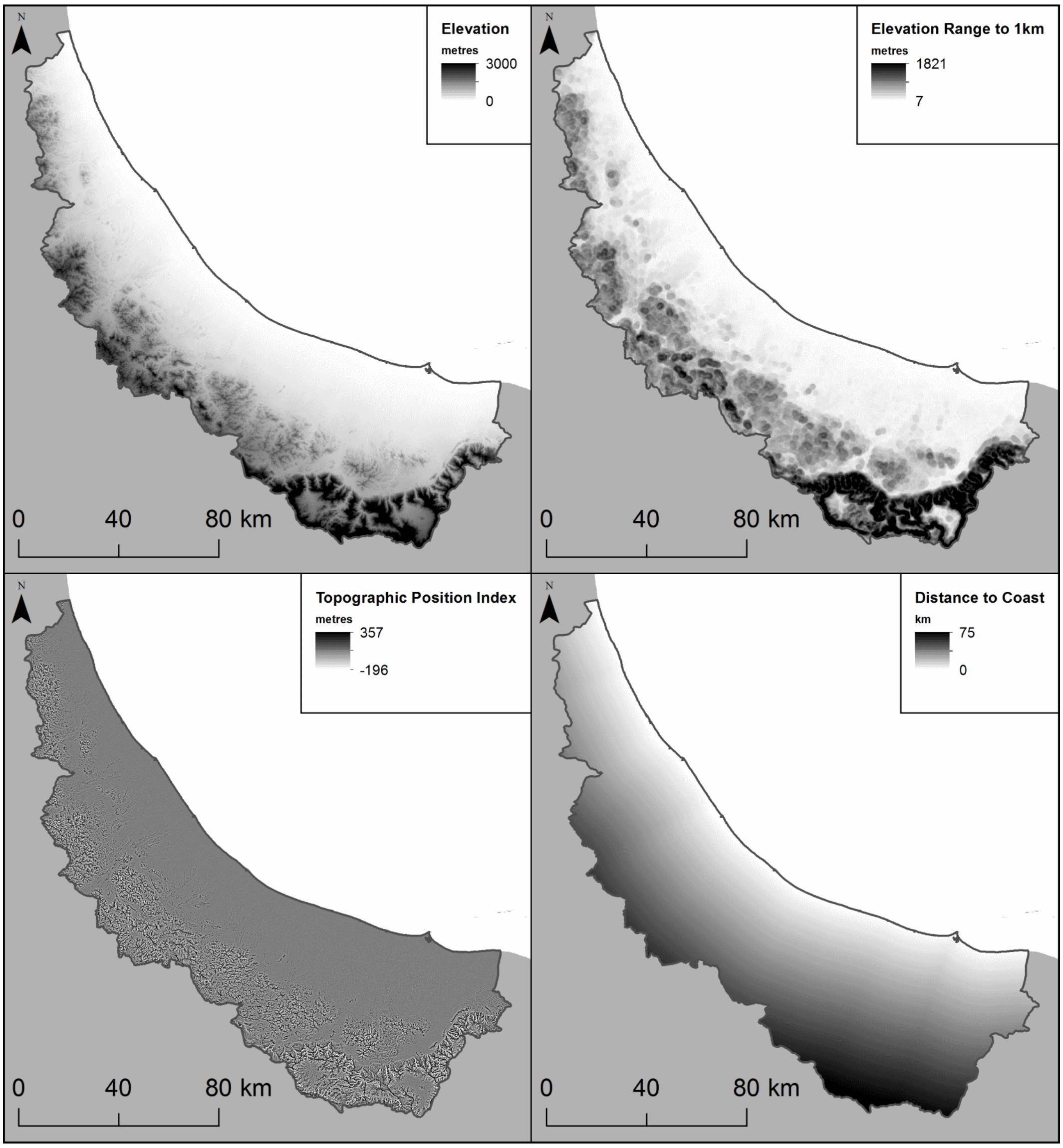


Figure 5.63: Batinah landscape data — elevation and topography variables: 'elevation'; 'elevation range'; 'Topographic Position Index' (TPI); and 'distance to coast'

outside of the Batinah, creating a Batinah landscape control for each variable and a source to write data values to each individual Hafit tomb and LPT based on their location[18].

Hydrology: During qualitative evaluation, a reasonably strong relationship was observed between Hafit tombs and the surface hydrology of the Batinah. The tombs were frequently found in close proximity to wadi channels of all sizes, usually in the area as they pass through the bajada, before dispersing and sinking into the gravel plain. The tombs were repeatedly observed on high ground running along the course of the wadis,

[18]using the **Clip Tool** and the **Extract Values to Points Tool** as described above

and in elevated areas between wadis. LPTs showed a similar pattern, but they were observed in greater numbers further downstream towards the coast and upstream towards the rocky foothills. The accuracy of these observations was assessed through the analysis of two hydrological variables: ‘distance to wadi’; and ‘maximum drainage area of wadi’. Measuring the distance between each tomb and the nearest sizeable wadi channel will enable these observations to be tested. By calculating the drainage area of the largest wadi channel within a set distance of each tomb it will be possible to take the size of the wadis into account in the analysis.

The hydrological analyses use the ASTER GDEM as a primary data source. This elevation data was used to create a hydrological model of the Batinah, mapping the course of wadis and the size of their drainage area upstream at each point[19]. Further analysis was then carried out to locate the largest wadi within 1km of every pixel of the model, writing the surface area of its upstream drainage to a new dataset[20]. The model was also used to generate a new dataset mapping the distance of every pixel to the nearest wadi channel with a drainage area of 10 sq-km or larger[21] — the equivalent of a small stream or above according to a World Health Organisation river classification system (Table 5.18). The datasets for these two hydrological variables — ‘drainage area of largest wadi’ (within 1km), and ‘distance to nearest wadi’ (Figure 5.64) — were limited to the boundaries of the Batinah and written to each individual Hafit tomb and LPT.

Table 5.18: WHO classification of river size based on drainage area (Chapman 1996: table 6.1)

River Size	Drainage Area (sq-km)	Example
very large river	> 1,000,000	Amazon
large river	100,000–1,000,000	Danube
river	10,000–100,000	Severn
small river*	1,000–10,000	Tyne
stream	100–1,000	—
small stream	10–100	—
brook	< 10	—

*largest watercourse present in the northern Oman Peninsula

[19]the **Hydrology Toolset** was used to generate flow direction and flow accumulation datasets for the Batinah area; the **Reclassify Tool** was then used to convert the pixel-count field of the flow accumulation dataset into a simple hydrological map of wadi channels; the **Raster to Polyline Tool** was then employed to convert this dataset into a ArcGIS shapefile

[20]the **Focal Statistics Tool** was used on the flow accumulation dataset with the circular option selected and the analysis carried out to a 1km radius; the **Raster Calculator Tool** was used to convert the units from pixel-count to drainage area in sq-km — by multiplying the raster by 0.0009, as the DEM grid is 30x30m

[21]**Euclidean Distance Tool** was applied to the wadi shapefile

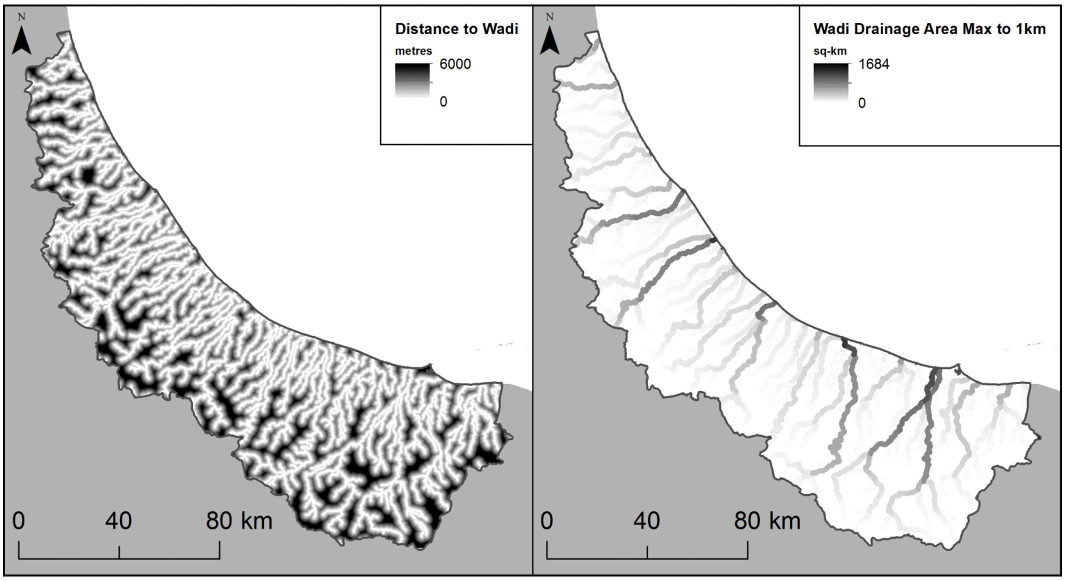


Figure 5.64: Batinah landscape data — hydrology variables: 'distance to wadi'; and 'drainage area of largest wadi' (within 1km)

Geology: During the qualitative evaluation phase, it was observed that Hafit tombs were most strongly associated with the low hills of the Quaternary fluvial material of the bajada. A small number of tombs were observed in the rocky foothills at the base of the Hajar Mountains, with a small number also found at the edge of the ophiolite fields. However, a large — highly disproportionate — number were observed on or very near to a ridge of pale buff Tertiary rock that runs discontinuously through the bajada zone, roughly parallel to the line of the coast and mountains. LPTs showed a similar geological distribution, but a greater number were observed in the ophiolite hill zone, and the tombs showed a weaker relationship to the Tertiary ridge.

Vector-based geological GIS data of Oman and the U.A.E. is not publicly available, and so analysis of the geology had to be highly targeted. Three geological variables were investigated — 'distance to the Tertiary ridge', 'Tertiary ridge zone', and 'distance to copper ore source' (Figure 5.65). The disproportionately strong relationship between the Hafit tombs and the discontinuous Tertiary ridge demanded investigation. The fact that the copper ore of the Batinah, usually associated with the ophiolite, is so widespread — to the point that mining is commercially viable today — meant that this resource also had to be investigated. The location of the Tertiary ridge was plotted using Google Earth, guided by a geological map of Oman (Le Métour et al. 1993). The location of copper ore sources in Oman and the U.A.E. had already been mapped for the previous chapter (Chapter 4.5.1).

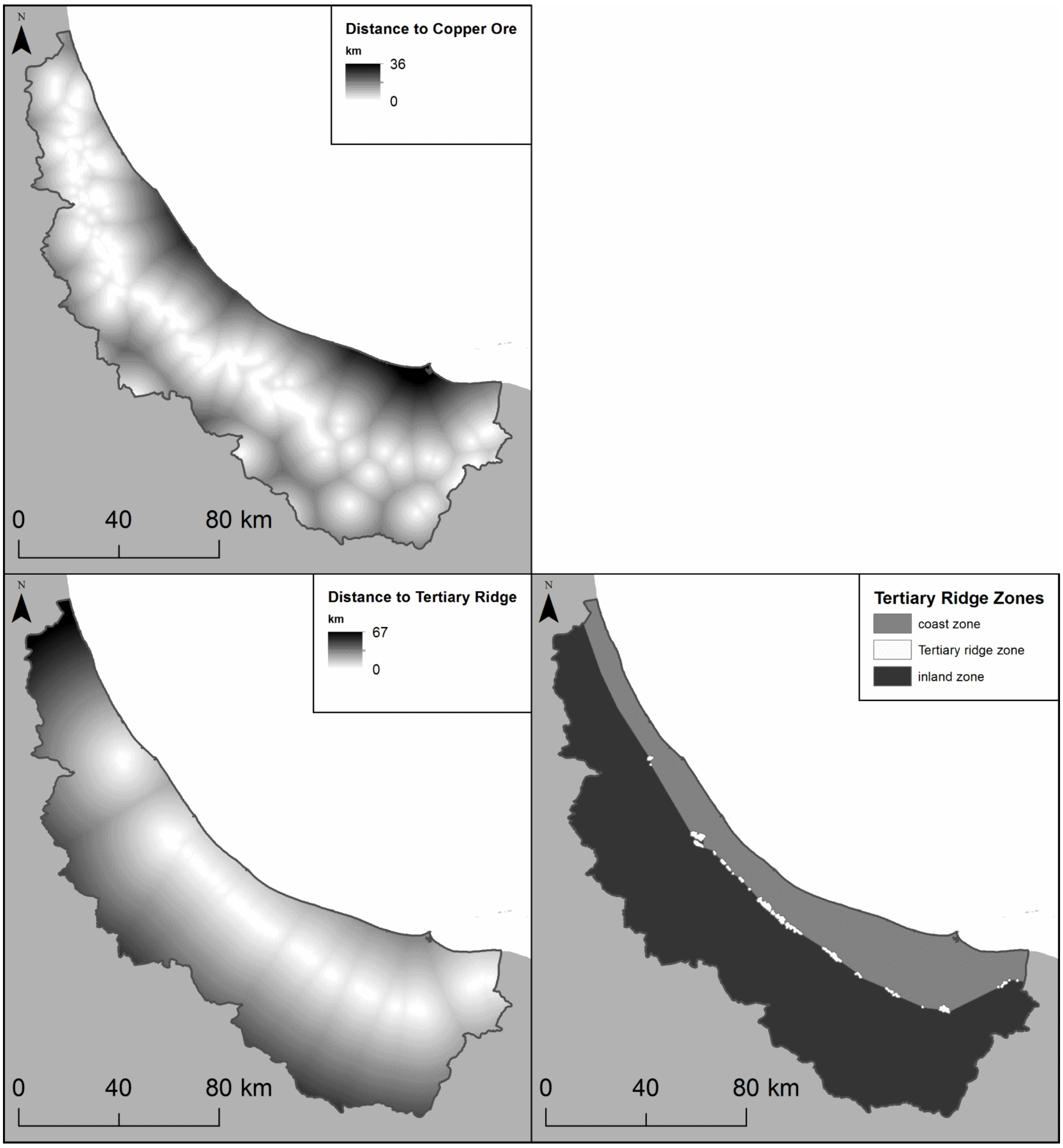


Figure 5.65: Batinah landscape data — geology variables: 'distance to copper ore'; 'distance to Tertiary ridge'; and 'Tertiary ridge zone'

To generate the 'distance to copper ore' dataset, ArcGIS was used to automatically measure the distance to a known copper ore source from every part of the Batinah, and to write this to a new dataset. An identical method was used for the 'distance to Tertiary ridge' variable, using the rocky outcrops location data[22]. For 'Tertiary ridge zone', the Batinah was divided into three zones — a 500m buffer area around the outcrops, the coastal zone to the north and east of the ridge line, and the inland zone to the south and

[22]both used to **Euclidean Distance Tool**

west — and the number of Hafit tombs and LPTs to fall within each was counted[23]. Each of these three datasets was limited to the geographic extent of the Batinah, and was used to generate values for every Hafit tomb and LPT.

Modern settlement: Qualitative evaluation found that Hafit tombs overwhelmingly favour an area that is only very sparsely occupied in modern times — the bajada that lies between the modern agricultural villages on the coast and those in the low mountains and rocky foothills. The lack of Hafit tombs in the latter zone is significant, as it boasts large wadis where water is easily accessible and available in large volumes. LPTs follow a similar, but weaker, pattern — as they are also frequently located in the lowest hills nearest to the coastal villages, and in the rocky foothills at the base of the mountains.

These observations will be tested through the analysis of two variables: 'distance to modern settlement'; and 'density of modern settlement' (Figure 5.66). The same 1980s dataset will be employed that was described in the previous chapter as it more accurately reflects traditional settlement patterns than the modern maps which post-date a phase of rapid urbanisation and population growth (Chapter 4.5.1).

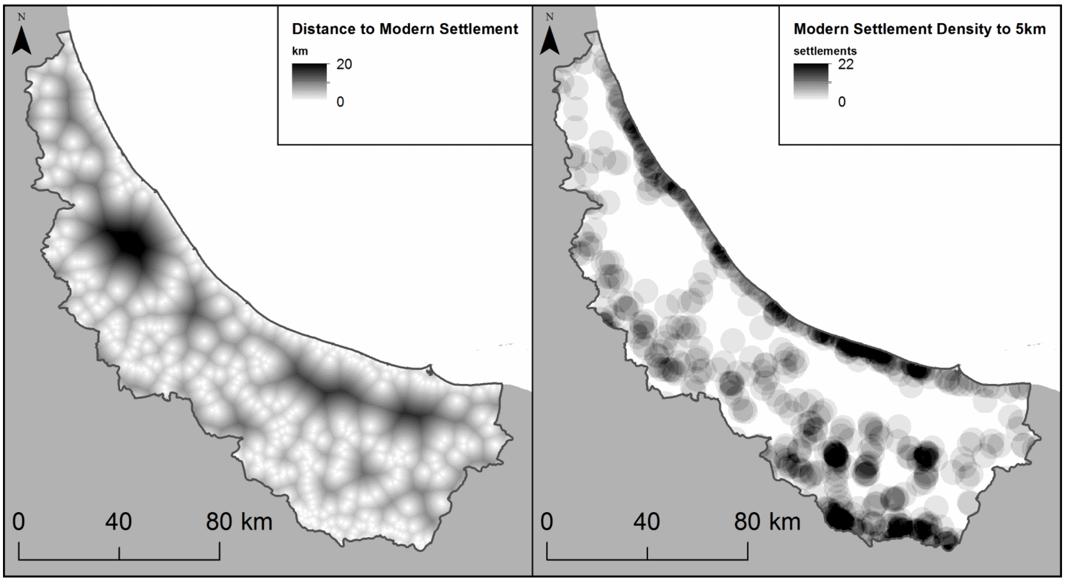


Figure 5.66: Batinah landscape data — modern settlement variables: 'distance to modern settlement'; and 'density of modern settlement' (to 5km)

[23] the Tertiary ridge zone dataset was created by first using the **Buffer Tool** to create a 500m zone around the Tertiary ridge feature class; the approximate line of ridge was drawn across the length of the Batinah, and these two feature classes were intersected with a polygon of the Batinah using the **Intersect Tool** to create the three zones; finally, the resulting feature class was converted into a raster using the **Polygon to Raster Tool**

The distance to the nearest recent settlement was automatically measured for every part of the Batinah and written to a new dataset for the 'distance to modern settlement' variable[24]. For 'density of modern settlement', ArcGIS was used to generate a density map based on the 1980s villages, counting the number of recent settlements within 5km for every part of the Batinah[25]. These datasets were trimmed to the geographic extent of the Batinah, and were used to provide values for the Hafit tombs and LPTs.

5.4.3 Results

The GIS analysis results are presented below. Firstly, the analysis of the spatial relationship between tombs, and then analysis of the distribution of the tombs within their natural and anthropogenic environment.

Spatial distribution

The spatial distribution analyses test and quantify observations of three 'levels' of tomb grouping, and compare the distribution of Hafit tombs and LPTs. The density of Hafit tombs and LPTs is analysed, as well as the spatial relationships between tombs at short, medium, and long range. How neighbouring Hafit tombs and LPTs form Clusters, Necropolises and Agglomerations will also be examined. Finally, the relationship between Hafit tombs and LPTs will be analysed.

Analysing tomb density reveals clear differences in the distribution of Hafit tombs and LPTs (Figure 5.67). Despite boasting almost 2,000 fewer tombs the Hafit density map covers a larger area with tombs more widely dispersed, while LPTs are concentrated within a smaller area and boast hotspots of high density. The maximum, mean and standard deviation of tomb density are all significantly smaller in the Hafit dataset (Table 5.19).

Table 5.19: Descriptive statistics — Hafit tombs and LPTs density at a 1km radius (tombs/sq-km)

	Hafit	LPTs
Maximum	64.0	276.0
Minimum	0.3	0.3
Mean	6.3	10.1
Standard Deviation	8.7	19.8

[24] the **Euclidean Distance Tool** was used
[25] the **Point Density Tool** was used, set to a 5km radius

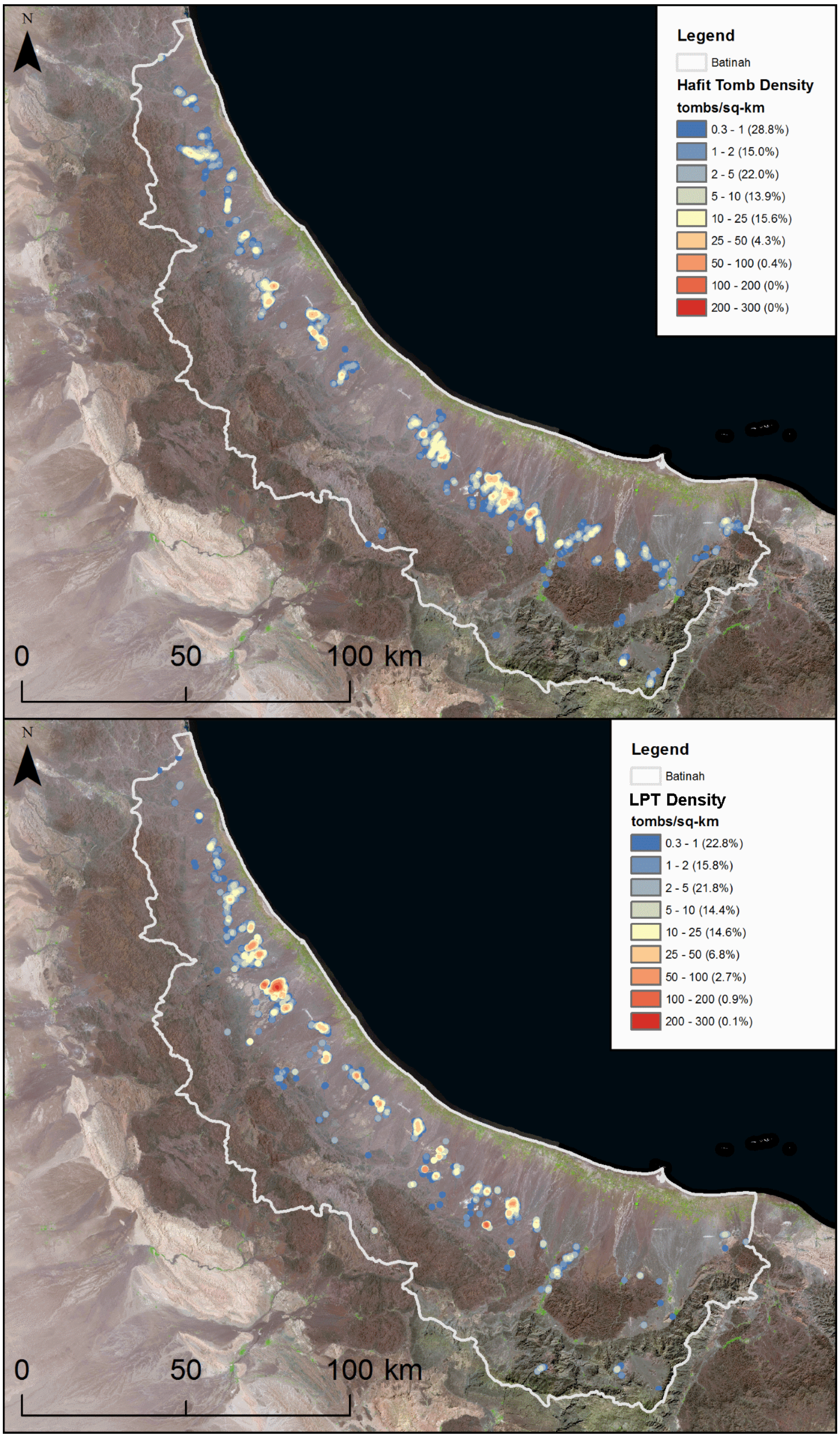


Figure 5.67: Density of Hafit tombs and LPTs

At a short range distance of up to 100m, Hafit tombs have far fewer near neighbours than LPTs (Table 5.20): although the number of Hafit tombs is ~75% that of the LPTs, they boast fewer than a fifth of the number of near neighbour relationships, with the average number per tomb a quarter of that of the LPTs. Across the spread of short range values — ten classes running in regular intervals from 0 to 100m — the proportion of near neighbour relationships differ markedly (Figure 5.68). The proportion of LPT relationships is relatively stable around the mean (10%), with a low peak at the lower end; while the proportion of Hafit tomb near neighbour relationships show a clear upward trend as the distance between tombs increases. At short range, Hafit tombs boast far fewer neighbours than LPTs, with an unequal proportion of the spatial relationships occurring at further distance — they are much less tightly clustered.

Table 5.20: Near neighbour relationships of Hafits tombs and LPTs at short range (up to 100m)

	Hafit			LPTs		
Distance (m)	μ/tomb	total	%	μ/tomb	total	%
10	0.1	450	2.2	0.8	6466	9.2
20	0.3	1730	8.6	1.3	10,752	12.0
30	0.3	1742	8.2	1.2	10,058	8.9
40	0.3	1914	9.2	1.2	10,490	9.0
50	0.3	2070	9.9	1.3	11,064	8.8
60	0.3	2194	10.9	1.4	11,664	9.3
70	0.4	2288	10.9	1.5	12,398	10.3
80	0.4	2636	12.9	1.5	12,548	10.4
90	0.4	2612	12.9	1.5	12,772	10.5
100	0.4	2850	14.3	1.6	13,294	11.6
Total	3.2	20,486	100.0	13.1	111,506	100.0

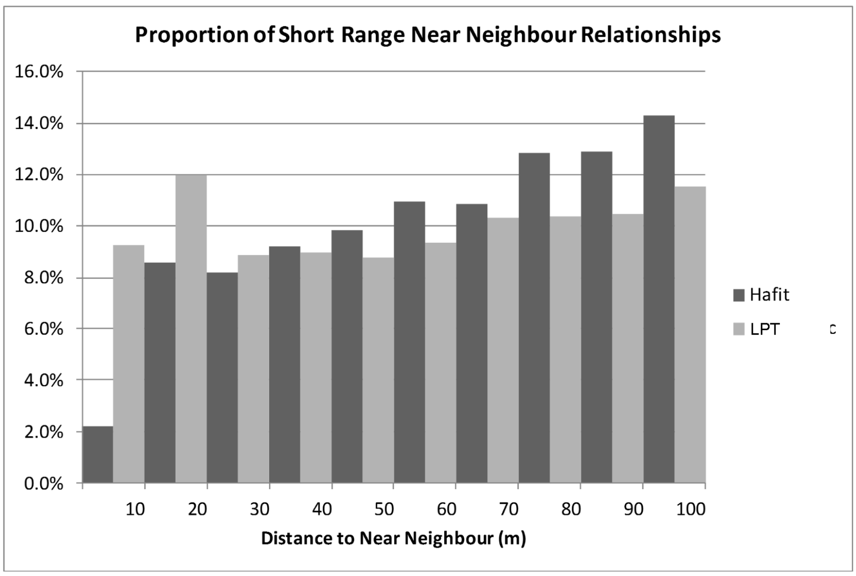


Figure 5.68: Graph — near neighbour relationships at short range (up to 100m)

At a medium range distance of up to 1000m, Hafit tombs still have far fewer near neighbours than LPTs (Table 5.21). The total number of Hafit relationships is less than a third that of LPTs, and the mean number per Hafit tomb is only 40% that of the later tombs number. Moreover, the proportion of the distances of the near neighbour relationships differ markedly across the ten classes (Figure 5.69). The Hafit data demonstrates a general upward trend — the greater the distance between tombs, the larger the number of near neighbour relationships — while the LPT data shows almost the opposite pattern. At medium range, Hafit tombs have fewer near neighbours than LPTs, with an unequal proportion occurring at further distance, while LPTs have a greater number of near neighbours at closer distance.

Table 5.21: Near neighbour relationships of Hafits tombs and LPTs at medium range (up to 1000m)

	Hafit			LPTs		
Distance (m)	μ/tomb	total	%	μ/tomb	total	%
100	3.2	20,486	7.1	13.1	111,506	13.5
200	5.2	33,256	9.1	15.6	132,788	11.2
300	5.8	36,800	9.3	17	144,578	10.0
400	6.4	41,050	9.7	19.2	163,236	9.8
500	7.1	45,394	10.1	19.9	169,410	9.8
600	7.5	47,652	10.3	19.1	161,912	9.2
700	7.4	47,144	10.4	18.6	158,440	8.8
800	7.4	47,388	10.6	17.9	151,724	8.8
900	7.8	49,652	11.2	18.1	153,632	9.1
1000	8	50,894	12.1	18.3	155,268	9.7
Total	65.7	419,716	100.0	176.8	1,502,494	100.0

At long range distances of up to 4000m, Hafit tombs still have a significantly smaller number of near neighbours than the later structures (Table 5.22). The total number of Hafit relationships is approximately a third of the number of that of the LPTs, while the average number of near neighbours per Hafit tomb is only 45% that of the LPT number. Furthermore, the proportion of the distances to near neighbours differs significantly (Figure 5.70). The Hafit distribution is relatively stable around the mean, while a disproportionately high number of LPT near neighbours are at a low distance and a correspondingly low number are at a medium-high distance. At long range, Hafit tombs have fewer near neighbours than LPTs with a fairly equal proportion occurring at all distances, while LPTs have a greater number of near neighbours at close distance.

There are significant differences between Hafit and LPT Clusters (Figure 5.71, Table 5.23). Hafit Clusters contain far fewer tombs and boast a significantly larger proportion of single tomb Clusters. The distances between tombs in the same Cluster is greater for

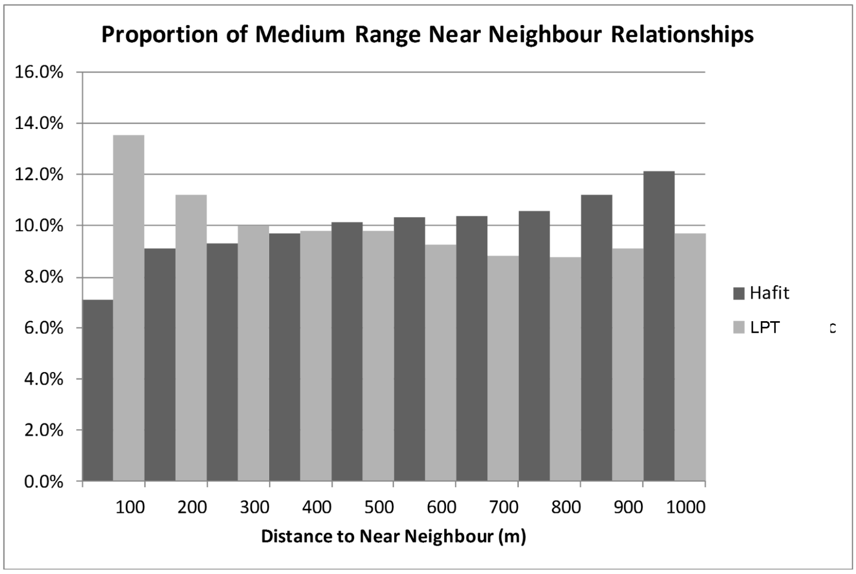


Figure 5.69: Graph — near neighbour relationships at medium range (up to 1000m)

Table 5.22: Near neighbour relationships of Hafits tombs and LPTs at long range (up to 4000m)

	Hafit			LPTs		
Distance (m)	µ/tomb	total	%	µ/tomb	total	%
400	20.6	131,592	9.8	65	552,108	16.7
800	29.4	187,578	10.9	75.5	641,486	12.3
1200	31.9	203,842	10.8	73.6	625,788	9.9
1600	34.3	219,150	10.6	83.8	712,060	10.2
2000	35	223,584	10.2	84.7	720,092	10.0
2400	34.7	221,988	9.9	67.8	576,428	7.9
2800	33.8	215,788	9.1	66.3	563,638	7.3
3200	35	223,390	9.1	71.6	608,494	7.7
3800	34.9	223,118	9.3	71.2	604,718	8.3
4000	36.5	233,084	10.2	71.9	611,068	9.6
Total	326.0	2,083,114	100.0	731.5	6,215,880	100.0

Hafit tombs. In particular Hafit tombs have far fewer near neighbours (other structures within 100m), and despite this show a greater average distance between near neighbouring structures. In general, because of the much greater number of tombs that they contain, LPT Clusters are larger than the Hafit groupings, but despite this size difference the density of tombs is significantly lower in Hafit Clusters. In comparison with the LPT groupings, Hafit Clusters: contain fewer tombs; are more likely to consist of only a single structure; contain tombs that are more distant from one another; are smaller in total area; and have a lower density of tombs (Figure 5.72).

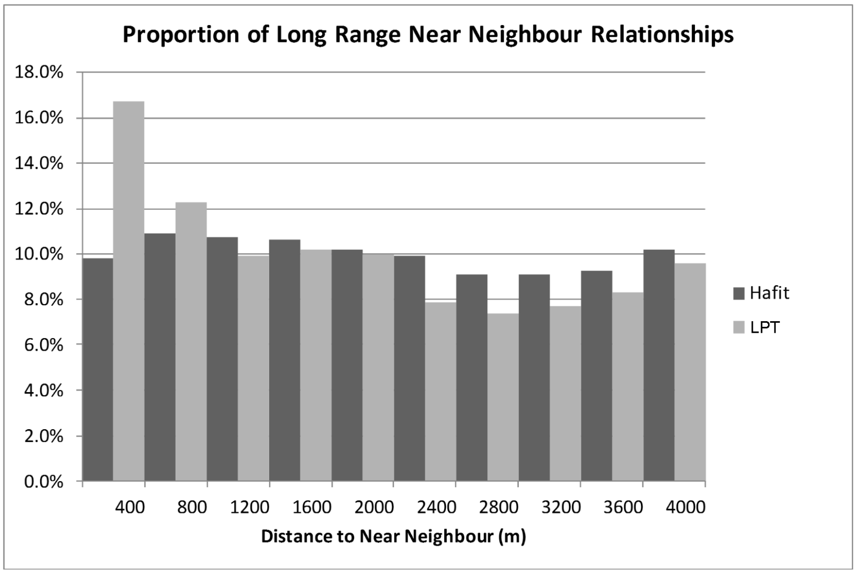


Figure 5.70: Graph — near neighbour relationships at long range (up to 4000m)

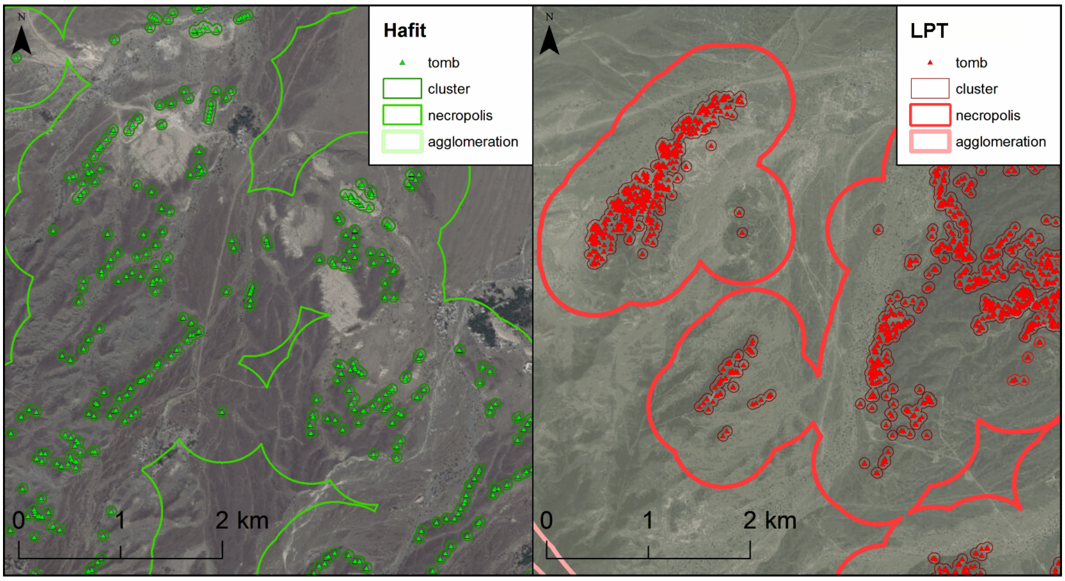


Figure 5.71: Comparison of examples of Hafit and LPT Clusters

There are equally stark differences between Hafit and LPT Necropolises (Figure 5.73, Table 5.24). Hafit Necropolises generally contain a much greater number of Clusters, but fewer tombs. Hafit Necropolises are less likely to consist of a single Cluster, but are more likely to contain only one tomb. Hafit Clusters are found at a greater distance from each other, but generally boast a greater number of near neighbours. Despite containing fewer tombs, Hafit Necropolises are significantly larger, and therefore have a much lower tomb density. In comparison with LPT Necropolises, the Hafit groupings: contain more Clusters but fewer tombs; are more likely to consist of a single tomb but less likely to

Table 5.23: Descriptive statistics — Hafit and LPT Clusters

		Hafit	LPTs
Tombs		6,390	8,498
Clusters		2,179	1,108
Tombs per Cluster	mean:	2.9	7.7
	max:	83	869
Single tomb Clusters		1,172 (53.8%)	345 (31.1%)
Average maximum distance between tombs in same Cluster (m)		1,385.5	2,408.7
Average distance between all neighbouring tombs in same Cluster (m)		78.4	66.5
Average number of near neighbours per tomb	mean:	3.9	13.7
	max:	24	127
Average distance to near neighbours by tomb (m)	mean:	58.5	51.3
	max:	76.7	81.5
	min:	39.2	19
Area of Clusters (ha)	mean:	1.6	2.2
	max:	20.1	143.4
	min:	0.8	0.8
Density of tombs in Clusters (tombs/ha)	mean:	1.6	2.4
	max:	7.1	21.3
	min:	1.3	1.3

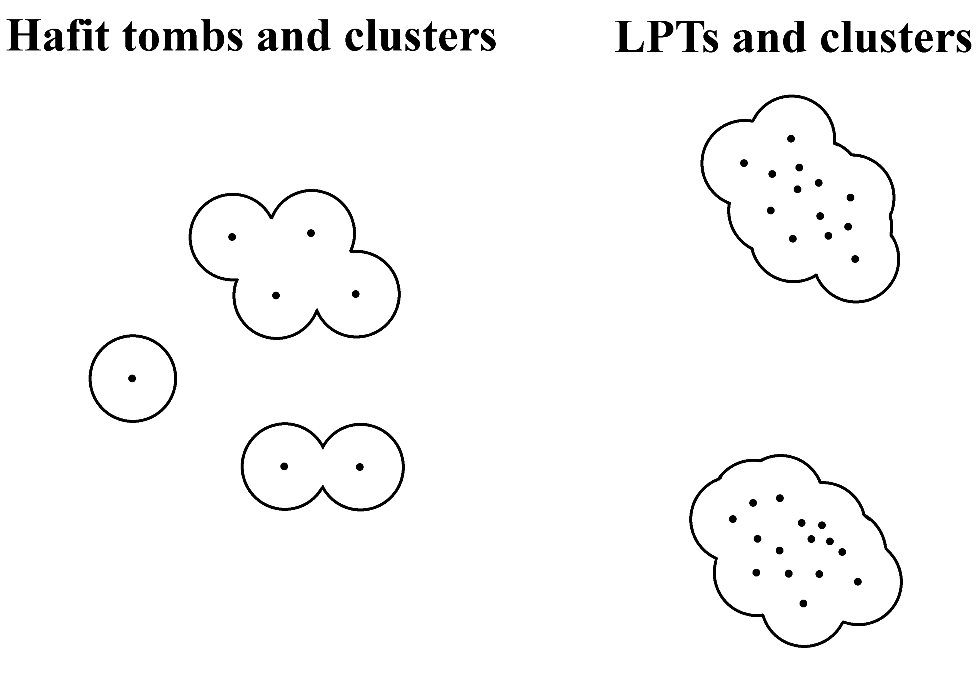


Figure 5.72: Conceptual diagram comparing Hafit and LPT Clusters

contain a single Cluster; encompass Clusters that are distributed at a greater distance from one another but which have fewer neighbours; are larger in area and have a significantly smaller tomb density (Figure 5.74).

The difference between Hafit and LPT Agglomerations are more subtle (Figure 5.75, Table 5.25). There are fewer Hafit Agglomerations, with each containing a greater number of Necropolises on average. Hafit Agglomerations are overall less likely to consist of only a single Necropolis, but are more likely to contain only a single tomb. Within Agglomerations, Hafit Necropolises have a similar number of near neighbours

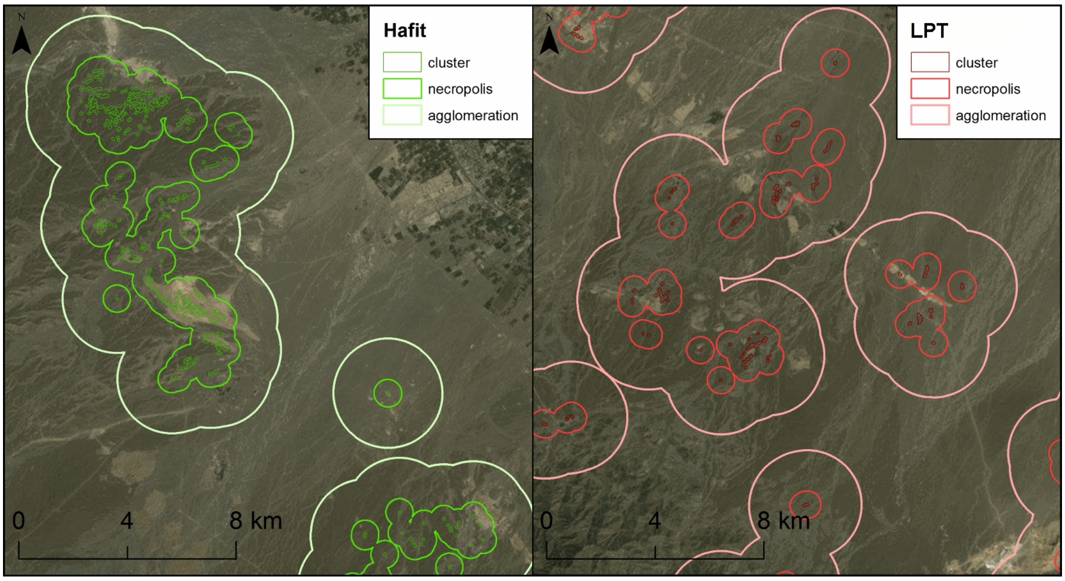


Figure 5.73: Comparison of examples of Hafit and LPT Necropolises

Table 5.24: Descriptive statistics — Hafit and LPT Necropolises

		Hafit	LPT
Tombs		6,390	8,498
Clusters		2,179	1,108
Necropolises		110	135
Clusters per Necropolis	mean:	19.8	8.2
	max:	450	93
Single Cluster Necropolises		26 (24.0%)	52 (38.5%)
Average maximum distance between tombs of different Clusters in same Necropolis (km)		14.2	7
Average distance between tombs of different Clusters in the same Necropolis (m)		906.5	739.1
Average number of near neighbouring Clusters	mean:	16.4	11.1
	max:	52	37
Average distance between tombs of near neighbouring Clusters (m)	mean:	565.5	526.9
	max:	904.0	845.7
	min:	175.9	194.9
Tombs per Necropolis	mean:	58.1	62.9
	max:	1,519	1,878
Single tomb Necropolises		14 (12.7%)	13 (9.6%)
Area of Necropolises (sq-km)	mean:	4.8	2.8
	max:	81.7	27.7
	min:	0.8	0.8
Density of tombs in Necropolises (tombs/sq-km)	mean:	6	12.9
	max:	26.9	93.4
	min:	1.3	1.3

and they are found at a similar distance from one another. Hafit Agglomerations are large in terms of area and contain a greater number of tombs on average, but the density of the structures is significantly lower. Although similar, Hafit Agglomerations are found at a closer distance from their nearest neighbour on average. When compared to the LPT groupings, Hafit Agglomerations: are fewer in number; contain a greater number of Necropolises; are less likely to consist of a single Necropolis, but more likely to contain

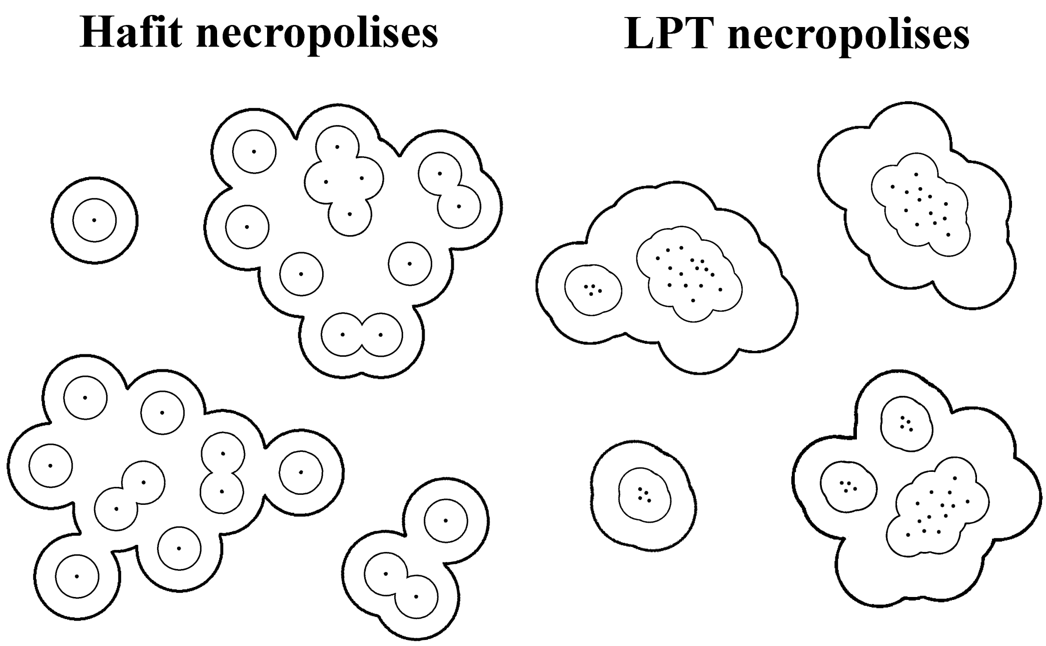


Figure 5.74: Conceptual diagram comparing Hafit and LPT Necropolises

only one tomb; have Necropolises that boast a similar number of near neighbours at a similar distance; have a greater surface area; a greater number of tombs; and a lower tomb density (Figure 5.76).

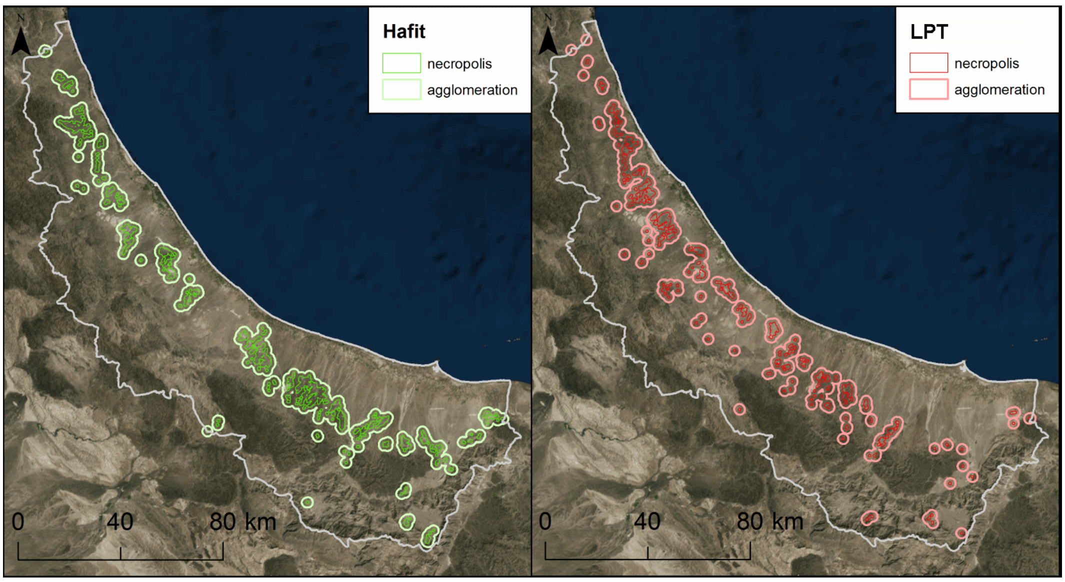


Figure 5.75: Comparison of the distribution of Hafit and LPT Agglomerations

The final analyses examine the spatial relationship between LPTs and Hafit tombs. The first analysis simply measured the distance between each LPT and the nearest Hafit structure. The statistics demonstrate the closeness of the relationship (Table 5.26): the

Table 5.25: Descriptive statistics — Hafit and LPT Agglomerations

		Hafit	LPTs
Tombs		6,390	8,498
Clusters		2,179	1,108
Necropolises		110	135
Agglomerations		29	45
Necropolises per Agglomeration	mean:	3.8	3
	max:	15	25
Single Necropolis Agglomerations		11 (38%)	26 (58%)
Average maximum distance between tombs of different Necropolises in same Agglomeration(km)		22.2	37.45
Average distance between tombs of different Necropolises in same Agglomeration (km)		3.76	3.72
Average number of near neighbouring Necropolises	mean:	2.9	3.0
	max:	8	7
Average distance between tombs of near neighbouring Necropolises (km)	mean:	2.15	2.24
	max:	2.82	2.92
	min:	1.52	1.60
Tombs per Agglomeration	mean:	220.3	188.8
	max:	2,187	2,627
Single tomb Agglomerations		2 (6.9%)	2 (4.4%)
Area of Agglomerations (sq-km)	mean:	67.5	41.6
	max:	356	367.7
	min:	12.6	12.6
Density of tombs in Agglomerations (tombs/sq-km)	mean:	1.9	2.2
	max:	6.3	19.3
	min:	0.1	0.1
Average distance between tombs of nearest neighbouring Agglomeration (km)	mean:	6.45	6.54
	max:	21.6	21.7

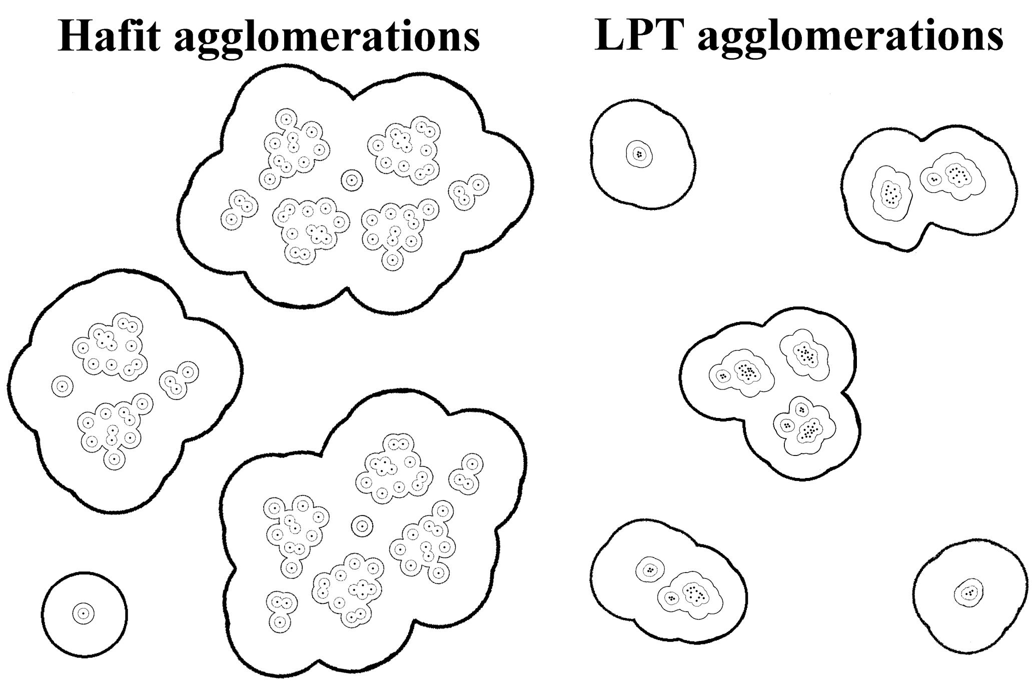


Figure 5.76: Conceptual diagram comparing Hafit and prehistoric Agglomerations

mean distance is just over 2.2km which is short considering the size of the Batinah, while the modal distance is much smaller at only 125m. The percentile values are particularly illuminating: 10% of LPTs are within 159m of a Hafit tomb; a quarter are within ~530m; and more than half are within 1.5km. A histogram presents the data clearly — all of the most numerous sets are within 1km of a Hafit tomb (Figure 5.77).

Table 5.26: Descriptive statistics — distance between LPTs and the nearest Hafit tomb

	Distance (m)
mean	2247.1
standard deviation	2398.8
mode	125
maximum	15,666
minimum	6
10th percentile	159.0
25th percentile	532.0
median	1478.5
75th percentile	3217.0
90th percentile	4653.3

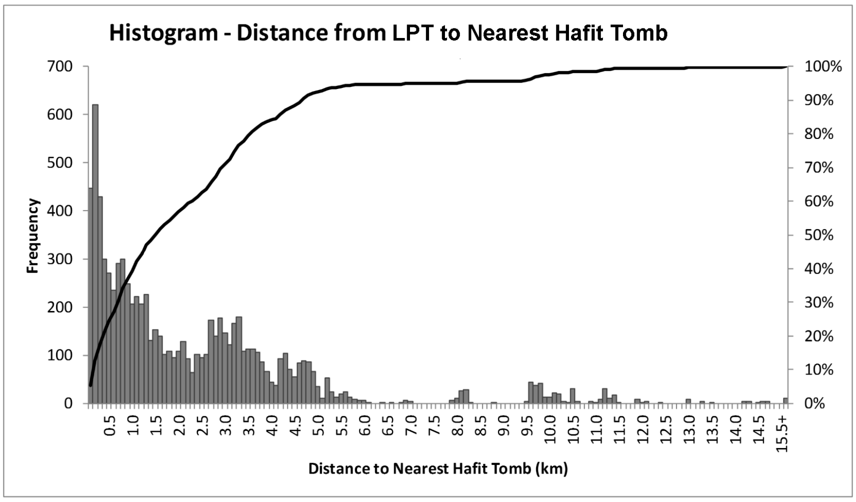


Figure 5.77: Histogram — distance between LPTs and the nearest Hafit structure

The second analysis counted the number of Hafit tombs within LPT Clusters, Necropolises and Agglomerations (Table 5.27). The groupings of LPTs show a close relationship with Hafit tombs: almost 5% of Clusters contain Hafit tombs, with an average of one Hafit tomb to every 10 LPT Clusters; more than 40% of Necropolises contain Hafit tombs, with an average of more than a dozen Hafit tombs per Necropolis (Figure 5.78); and two-thirds of Agglomerations also contain Hafit tombs, with an average of over a hundred Hafit tombs per Agglomeration, and as many as 762 Hafit tombs within a single LPT group.

Table 5.27: Descriptive statistics — presence/number of Hafit tombs in LPT Clusters, Necropolises and Agglomerations

	Clusters	Necropolises	Agglomerations
count	1,108	135	45
contains Hafit tombs	52 (4.7%)	57 (42.2%)	30 (66.7%)
mean no. Hafit tombs	0.11	12.67	103.91
max no. Hafit tombs	16	262	762

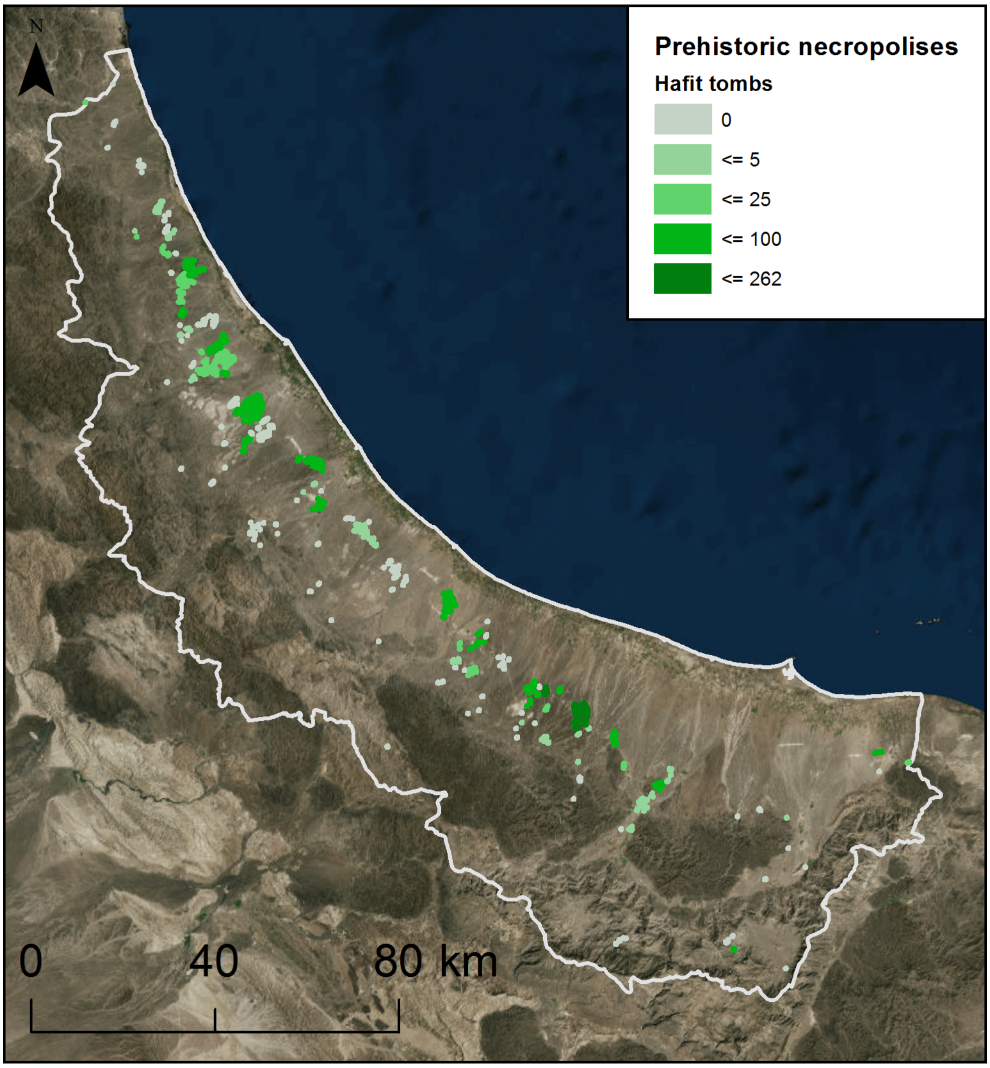


Figure 5.78: The number of Hafit tombs located within LPT Necropolises

The final analysis calculated the number of Hafit tombs within set, regular distances from LPTs. The results are summarised in the following table extract and graph (Table 5.28, Figure 5.79). On average, there is at least one Hafit tomb within slightly less than a 300m distance of each LPT, but at least one has as many as 44 Hafit tombs within this distance. There is a regular upward trend — as the distance from an LPT increases, the number of neighbouring Hafit tombs increases. LPTs are frequently found in close proximity to large numbers of Hafit tombs, suggesting a clear overlap in Hafit and later cemetery spaces.

Table 5.28: Data table extract — mean and maximum number of Hafit tombs found in proximity to LPTs

distance from LPT (m)	Hafit tombs mean	max
100	0.12	16
200	0.50	30
300	1.18	44
400	2.16	58
500	3.49	109
1000	13.55	182
1500	27.36	328
2000	43.99	426
2500	65.18	574
3000	88.98	698
3500	115.36	780
4000	146.35	832

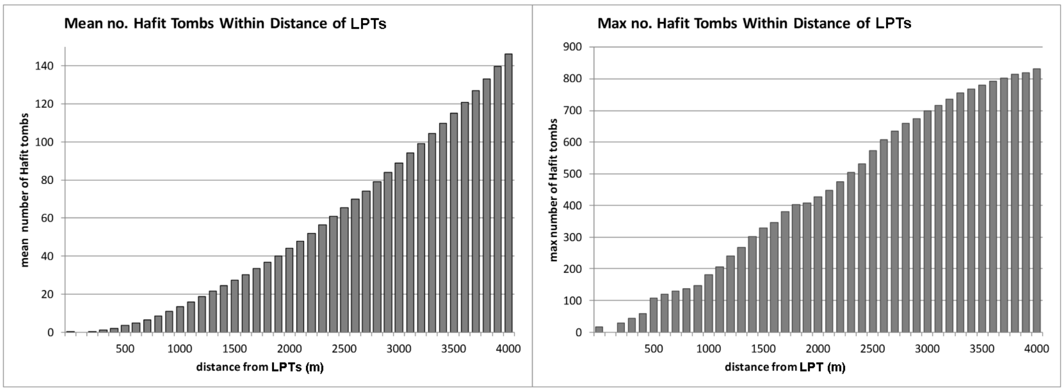


Figure 5.79: Mean and maximum number of Hafit tombs at set distances from LPTs

Environmental Distribution

Analysis of environmental and anthropogenic variables allow the distribution of Hafit tombs, LPTs, and the Batinah landscape to be modelled and compared. The results of GIS analysis of eleven variables across four categories will be presented.

Elevation and topography: The GIS analysis of elevation demonstrates that tombs are overwhelmingly found in a specific geographical zone of the Batinah (Figure 5.80). Tombs of both types are found in a relatively narrow ~1000m band, starting at just above sea level. However, the majority of tombs are found at the lower end of this spectrum, with Hafit tombs generally found in slightly more elevated areas than the LPTs — with mean values of 144 and 108m respectively, and median values even lower at 125 and 88m (Table 5.29). Both datasets have low standard deviation values that testify to a preference for areas not far above sea level.

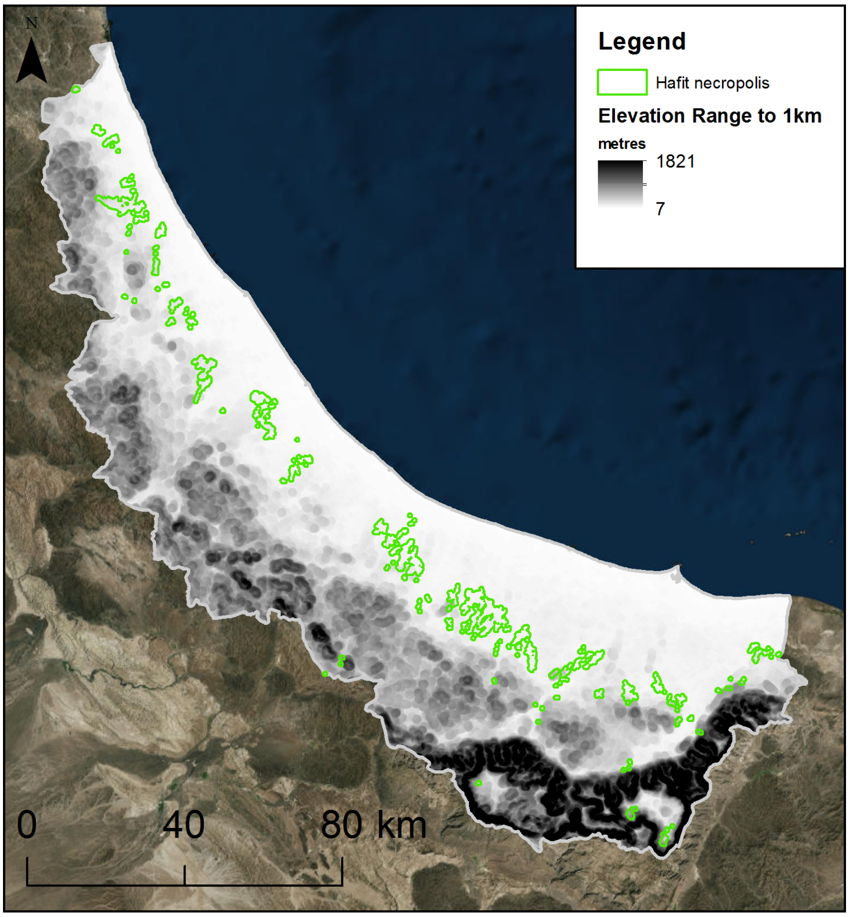


Figure 5.80: The distribution of Hafit Necropolises and the 'range in elevation' (to 1km)

Table 5.29: Descriptive statistics — 'elevation' in landscape, Hafits tombs, and LPTs (m)

	Landscape	Hafit	LPTs
Maximum	2981	1078	902
Minimum	0	28	12
Median	233	125	88
Mean	391.3	143.7	108.3
Standard Deviation	408.8	112.6	82.4

A histogram illustrating the distribution of the three datasets demonstrates this pattern even more clearly (Figure 5.81). No Hafit tombs are found within 25m of sea level, and a very small minority are found between 25 and 50m. The vast majority of Hafit structures are located between 75 and 225m. LPTs show a slightly wider distribution, with some between 0 and 25m and the majority between 50 and 250m above sea level. However, a small minority of Hafit tombs are found at a much greater elevation, between 650 and 1000m — a much higher proportion than LPTs. In both cases, the narrow band in which the majority of tombs are found is completely out of proportion with the Batinah landscape, demonstrating that specific and similar topographical areas were favoured by both populations.

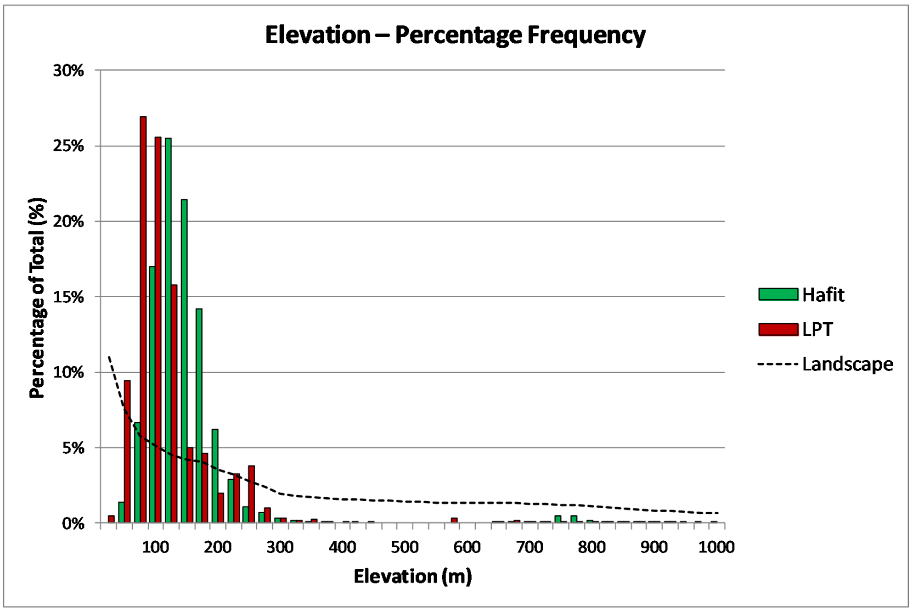


Figure 5.81: Histogram — 'elevation' in landscape, Hafits tombs, and LPTs

'Elevation range' (within 1km) shows an even tighter distribution in the Hafit and LPT datasets. While the maximum values — 474 and 553m — demonstrate that some tombs are found in rugged terrain, the low means (73 and 67m), lower medians (57 and 59m), and low standard deviations (52 and 43m) in comparison with the landscape as a whole suggest that the majority of tombs are found in areas where there is some, but not much, local variation in elevation (Table 5.30).

Table 5.30: Descriptive statistics — 'elevation range' in landscape, Hafit tombs and LPTs (m)

	Landscape	Hafit	LPTs
Maximum	1821	474	553
Minimum	7	24	26
Median	117	57	59
Mean	230.5	73	66.7
Standard Deviation	253.1	52.2	43.1

The histogram presents this pattern clearly (Figure 5.82). No tombs are located in the flattest part of the landscape with between 0 and 25m of variation within a 1km radius, despite this terrain making up more than 10% of the Batinah as a whole. The vast majority of Hafits tombs and LPTs are found in areas with between 25 and 125m of variation in elevation over this distance, with decreasing numbers of structures distributed in areas with a greater range in elevation and no tombs found in the most rugged terrains with over 575m of variation.

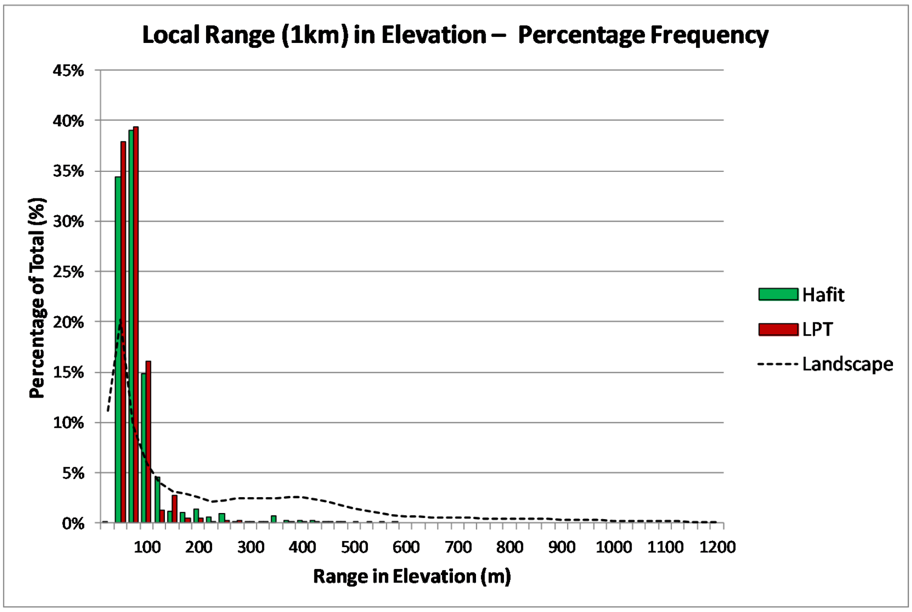


Figure 5.82: Histogram — 'elevation range' (to 1km) in landscape, Hafit tombs and LPTs

Analysis of 'Topographic Position Index' further adds to these observations. The descriptive statistics demonstrate that both types of tomb are generally found in slightly more elevated positions than the terrain of the Batinah as a whole — with mean values of 4.4 and 4m above for Hafit tombs and LPTs respectively and with both boasting a median of 3m — with no tombs of either type located at extremely high or low points of the landscape (Table 5.31).

Table 5.31: Descriptive statistics — 'Topographic Position Index' in landscape, Hafit tombs and LPTs (m)

	Landscape	Hafit	LPTs
Maximum	357	63	69
Minimum	−196	−39	−61
Median	0	3	3
Mean	0.5	4.4	4
Standard Deviation	22.9	9.6	9.1

The ‘TPI’ histogram reveals a normal-distribution of the Batinah landscape as a whole, and the tombs failing to conform to this pattern (Figure 5.83). The centre of the Hafit and LPT distributions are shifted a short distance to the right, and the distributions are clearly skewed towards this direction. The tails of the distributions are both considerably shorter and thinner than those of the landscape — the vast majority of all tombs are located in positions between 10m below and 30m above the average elevation of the surrounding area. Although not clear from this graphic, a clear majority of both tomb types were constructed in areas between 1 and 40m higher than their immediately surrounding, an area that represents a little over a quarter of the Batinah as a whole.

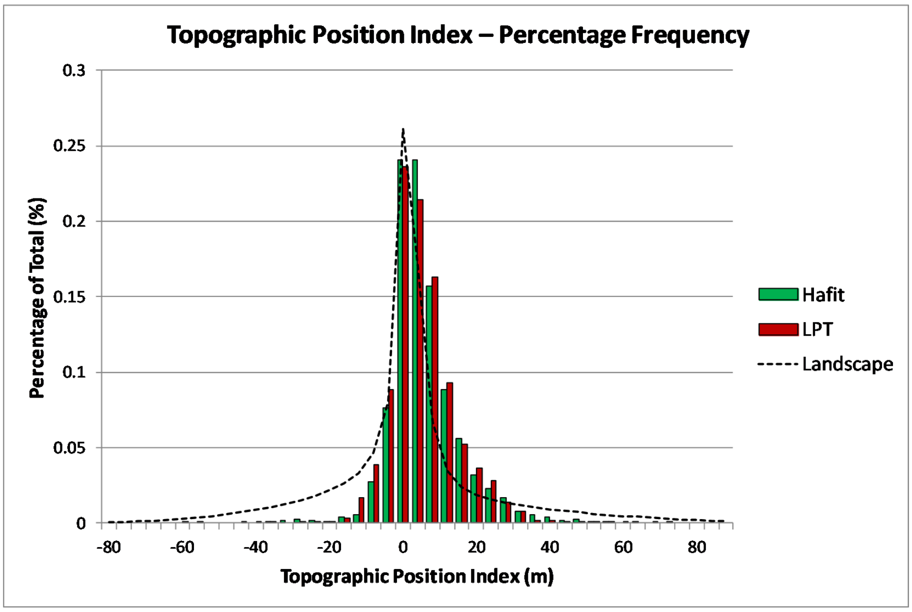


Figure 5.83: Histogram — ‘Topographic Position Index’ of landscape, Hafit tombs and LPTs

The ‘distance to coast’ statistics suggest that the both tomb datasets demonstrate quite a strong — but not a proximate — relationship with the coast. Both have a significantly lower maximum, median, mean and standard deviation than the landscape control (Table 5.32). However, no tombs are close to the coast — the nearest Hafit tomb is 5.5km away, and the closest LPT is 3.5km away. In general, LPTs are nearer to the sea than Hafit tombs.

The histogram shows the relationship clearly (Figure 5.84). The vast majority of all tombs are located at a distance of between 6 and 34km from the coast. LPTs show a little more variation, with greater numbers closer and further from the coast than this, but there is a larger minority of Hafit outliers that are found further than 60km from the sea.

Table 5.32: *Descriptive statistics — 'distance to coast' in landscape, Hafit tombs and LPTs (km)*

	Landscape	Hafit	LPTs
Maximum	75.5	64.8	66.4
Minimum	0	5.5	3.5
Median	26.7	18.6	14.0
Mean	28.4	20.0	16.0
Standard Deviation	17.7	8.8	7.8

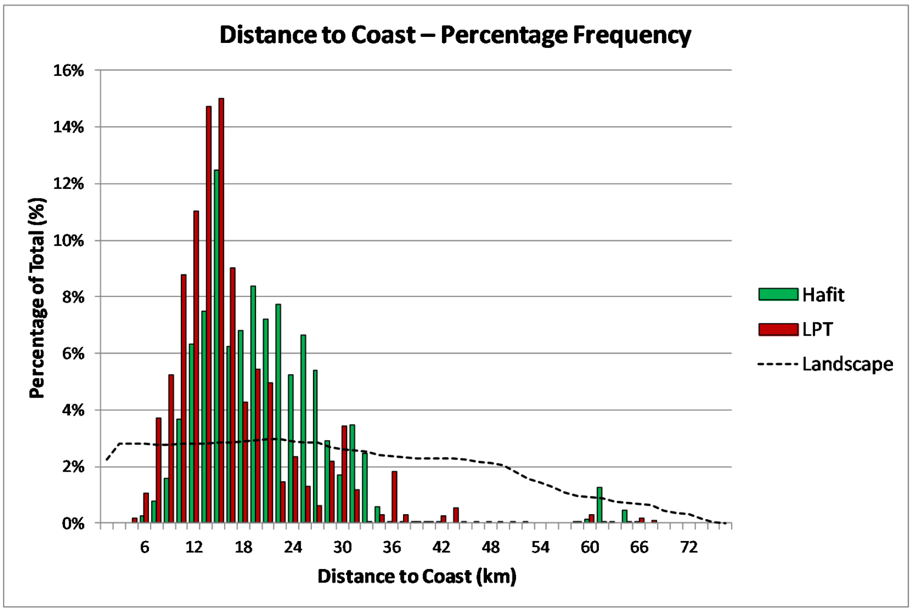


Figure 5.84: Histogram — 'distance to coast' in landscape, Hafit tombs and LPTs

Hydrology: The analysis of the hydrological variables reveals a strong relationship between Hafits tombs and LPTs and the wadi systems of the Batinah (Figure 5.85). Statistically, Hafits tombs and LPTs demonstrate a strong, proximate relationship to wadis. Their median and mean distances are significantly lower than the Batinah as a whole, and the standard deviation of both is also much smaller (Table 5.33). No tomb is found more than 3.4km from a wadi, despite parts of the Batinah being located ~6km away.

Graphically this pattern is even clearer. The number of Hafits tombs and LPTs within 1km of a wadi is disproportionate to the landscape as a whole (Figure 5.86). And while a significant proportion of the Batinah is located more than 2km from a wadi, only a tiny minority of Hafit — and even fewer LPTs — are found in these areas.

Although less clear-cut, the statistics describing the results of the wadi drainage area analysis suggest a similarly strong relationship between the tombs and the hydrology of the Batinah. The mean and median drainage area of the largest wadi within 1km of the

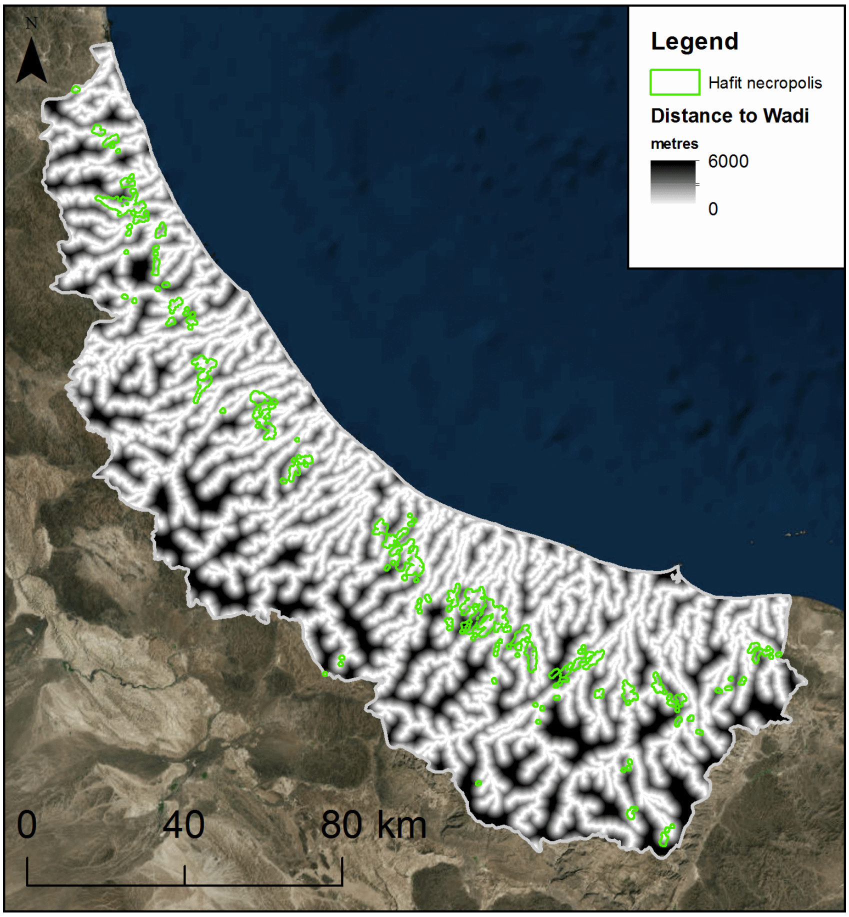


Figure 5.85: The distribution of Hafit Necropolises and the distance to sizeable wadis

Table 5.33: Descriptive statistics — 'distance to wadi' in landscape, Hafit tombs and LPTs (m)

	Landscape	Hafit	LPTs
Maximum	5963	3380	2704
Minimum	0	50	50
Median	851	559	538
Mean	1049	672	705
Standard Deviation	844	516	526

Hafit tombs are significantly larger than the landscape averages (Table 5.34). Interestingly, while the median value of the LPTs is even larger, the mean is slightly smaller than that of the Batinah as a whole.

The histogram illustrates the differing distribution of the three datasets (Figure 5.87). While some Hafits tombs and LPTs have only the equivalent of a large brook or a small stream in their immediate vicinity, the number that are found within 1km of sizeable

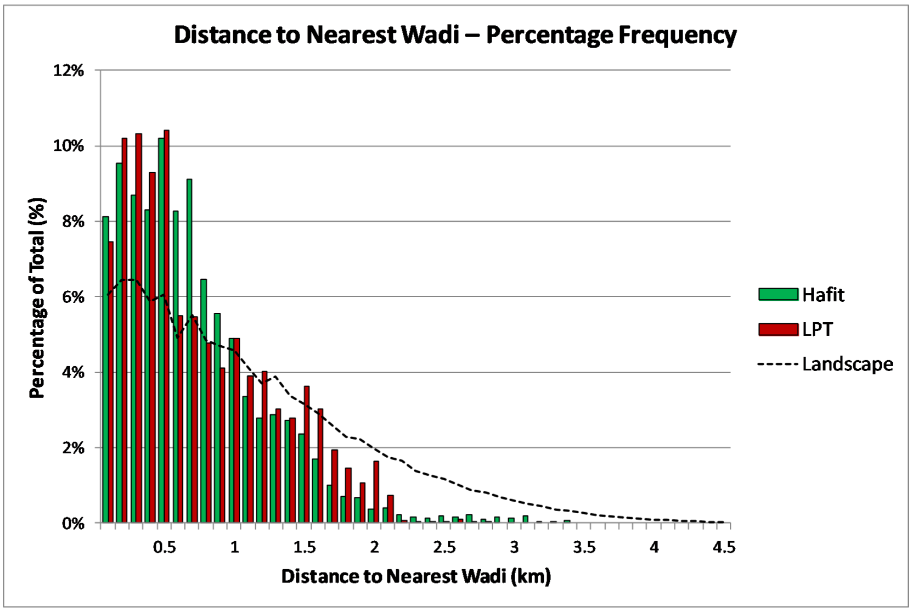


Figure 5.86: Histogram — 'distance to wadi' in landscape, Hafit tombs and LPTs

Table 5.34: Descriptive statistics — 'drainage area of largest wadi' (within 1km) in landscape, Hafit tombs and LPTs (sq-km)

	Landscape	Hafit	LPTs
Maximum	1684	881	857
Minimum	0	1	1
Median	12	29	35
Mean	89	100	85
Standard Deviation	188	171	129

watercourses that drain areas in excess of 100 sq-km — the equivalent of a large stream or small river — are significant. In general, Hafit tombs frequently appear to be found next to slightly large wadis than LPTs.

Geology: The spatial relationships between Hafits tombs and LPTs and the discontinuous Tertiary ridge (Figure 5.88), and sources of copper ore are clearly significant. The descriptive statistics demonstrate that both tomb types — but the Hafit tombs in particular — exhibit a surprisingly strong spatial link to the discontinuous ridge of Tertiary rock (Table 5.35). The mean distance of both tomb types to the geological feature is less than 8km, less than half the average of the landscape as a whole. Moreover, the median value for Hafit tombs is just over 2.7km — less than a sixth of the Batinah value, while the LPT median is less than a third of that of the control.

Presented graphically, the strength of the relationship is even starker — over a third of Hafit tombs and nearly a quarter of later structures are located within 1.5km of an outcrop of the Tertiary ridge, an area that makes up less than 4% of the Batinah landscape (Figure

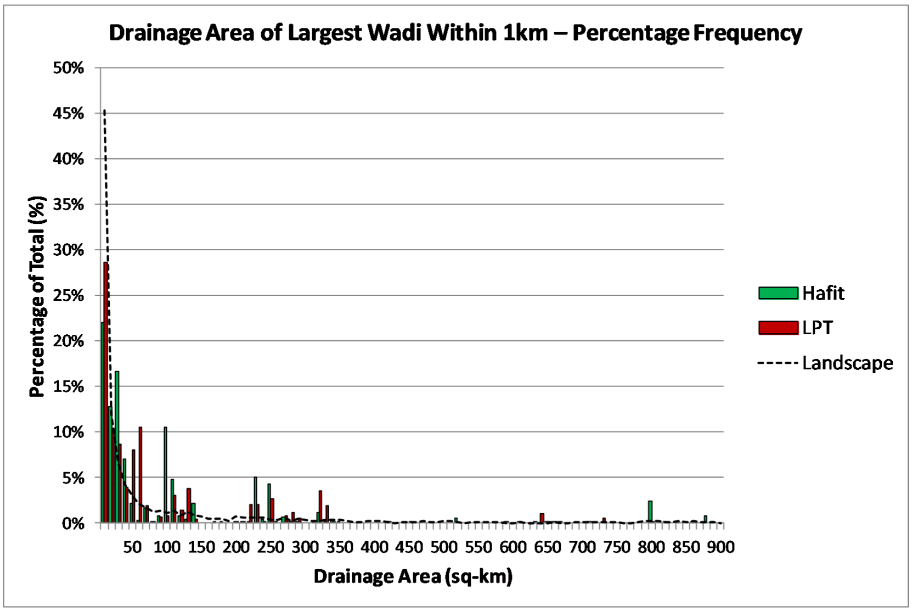


Figure 5.87: Histogram — 'drainage area of largest wadi' (within 1km) in landscape, Hafit tombs and LPTs

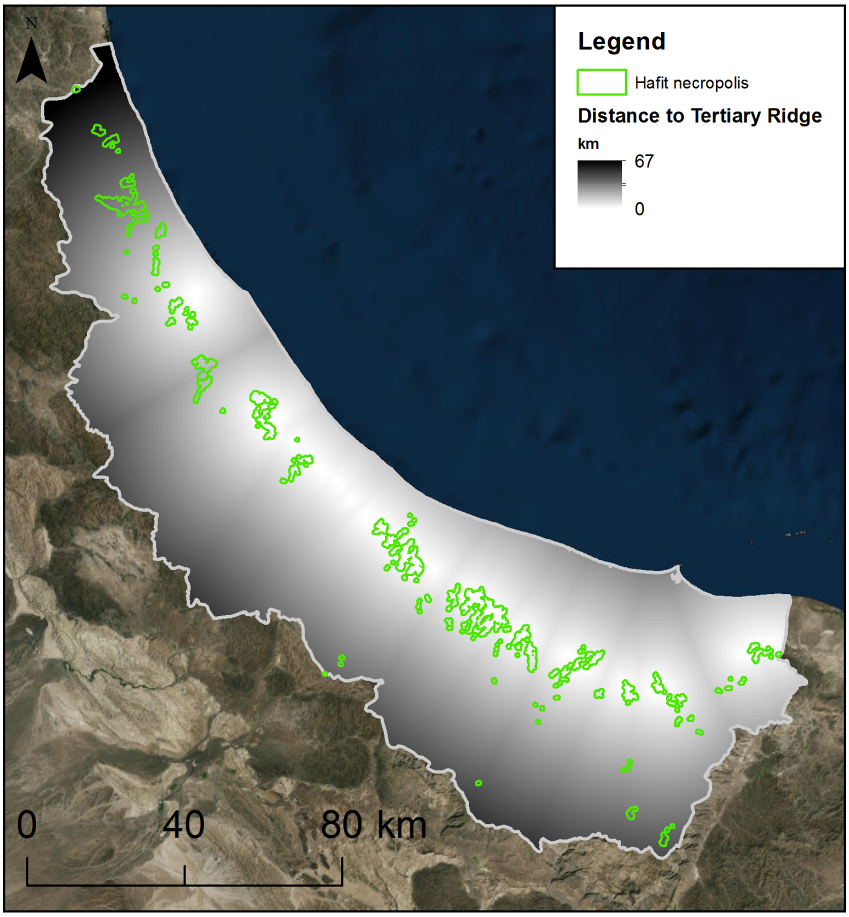


Figure 5.88: The distribution of Hafit Necropolises and 'distance to Tertiary ridge'

Table 5.35: *Descriptive statistics — 'distance to Tertiary ridge' in landscape, Hafit tombs and LPTs (km)*

	Landscape	Hafit	LPTs
Maximum	67.16	59.69	60.54
Minimum	0	0	0
Median	17.26	2.72	5.38
Mean	19.43	7.13	7.76
Standard Deviation	5.38	10.55	7.54

5.89). A majority of Hafit tombs and more than a third of LPTs are within 3km of the Tertiary ridge, an area that makes up only 7% of the Batinah. There is an extremely strong relationship between the tombs, in particular Hafit tombs, and this geological feature.

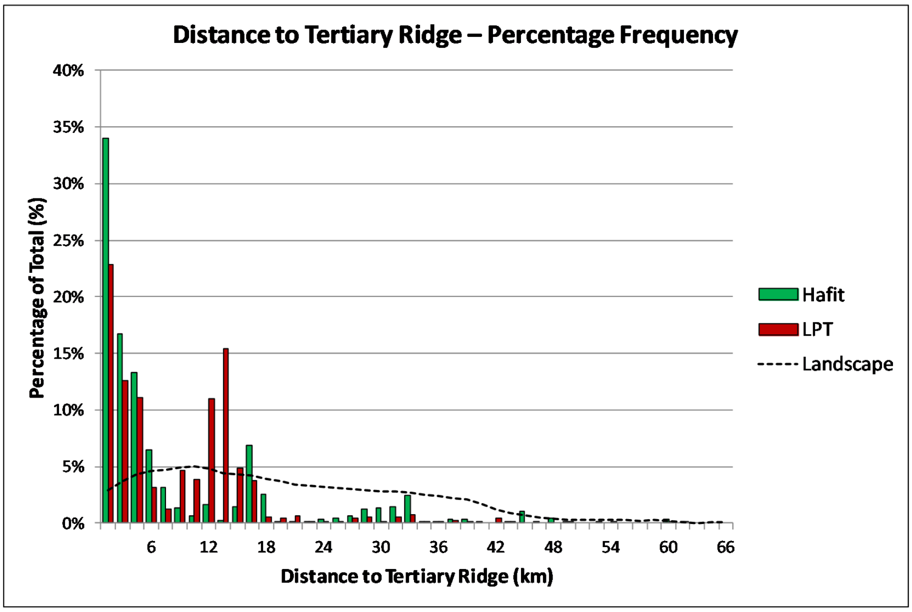


Figure 5.89: Histogram — 'distance to Tertiary ridge' in landscape, Hafit tombs and LPTs

The Tertiary ridge zone analysis further emphasises this relationship. 22% of Hafit tombs, and over 10% of LPTs fall within the 'Tertiary ridge zone' — i.e. they are located within 500m of the feature; this represents a surface area of just over 1% of the Batinah as a whole (Table 5.36, Figure 5.90). Interestingly — allowing for this extraordinary relationship — an unusually small proportion of Hafit tombs are found between the line of the ridge and the coast; the LPTs exhibit a similar if lesser preference for the inland side of the geological formation.

Analysis of tomb distribution also reveals a strong spatial relationship with sources of copper ore in the Batinah. The statistics suggest that Hafit tombs show a much stronger relationship than the LPTs — Hafit tombs have a much smaller maximum, median, mean and standard deviation than the Batinah average, while the contrast is less marked in

Table 5.36: Surface area/frequency and percentage of 'Tertiary ridge zones' in landscape, Hafit tombs and LPTs

	Landscape		Hafit		LPTs	
	Area (sq-km)	%	Tombs	%	Tombs	%
Coastal Zone	3587.9	27.3	908	14.2	1691	19.9
Tertiary Ridge Zone	149.3	1.1	1379	21.6	892	10.5
Interior Zone	9410.6	71.6	4103	64.2	5915	69.6

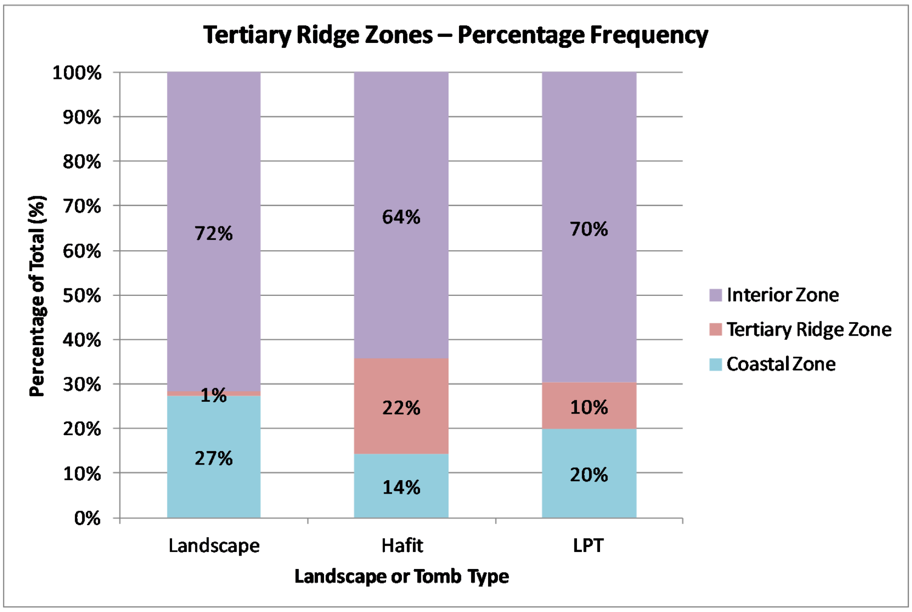


Figure 5.90: Percentage of landscape, Hafit tombs and LPTs within the 'Tertiary ridge zones'

LPTs (Table 5.37). On average a Hafit tomb is less than 5km from a source of copper ore, compared to just over 7km for the LPTs, and nearly 8.5km for the Batinah as a whole. The Hafit median is even smaller at just under 4.5km, compared to 7.2 and 7.3km. The fact that the Hafit standard deviation is so much smaller than the landscape value — 3.7 to 14.6 — is indicative of the strength and consistency of this relationship.

Table 5.37: Descriptive statistics — 'distance to copper ore' in landscape, Hafit tombs and LPTs (km)

	Landscape	Hafit	LPTs
Maximum	33.98	16.59	17.66
Minimum	0	0	0
Median	7.29	4.47	7.16
Mean	8.38	4.81	7.04
Standard Deviation	14.62	3.7	4.3

The differing distribution patterns are presented clearly in the histogram (Figure 5.91). More than a third of Hafit tombs are located within 3km of a source of copper ore, an area that makes up less than 20% of the Batinah; more than half are within 5km, an area that makes up approximately a third of the landscape. Conversely, within 10km of a copper ore source the proportion of LPTs is very similar to the landscape as a whole. However, a disproportionate number are found at a medium distance from the minerals — nearly a third of LPTs are found between 11 and 14km of copper ore, which represents less than 20% of the Batinah landscape. No tombs of either type are found more than 18km from such resources, unlike 9% of the Batinah as a whole.

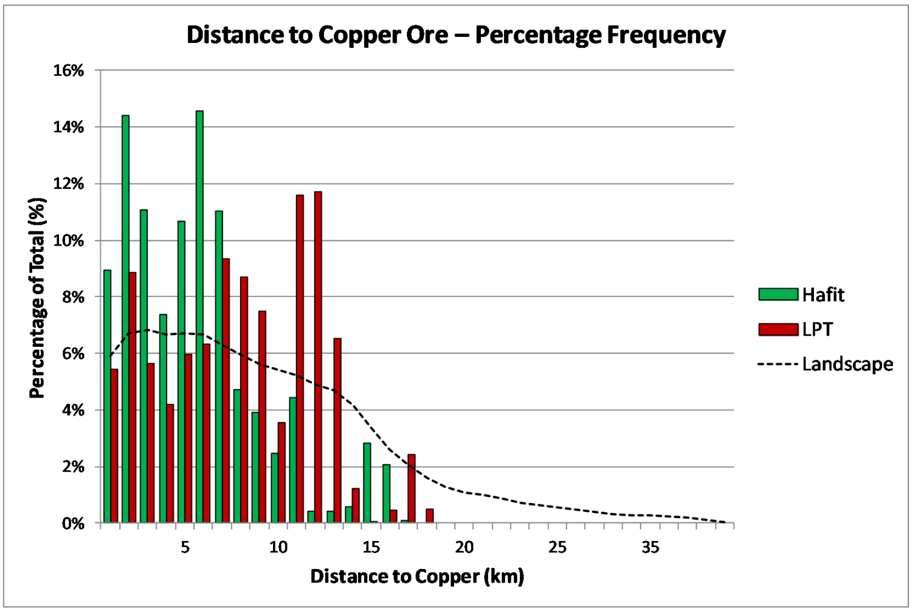


Figure 5.91: Histogram — 'distance to copper ore' in landscape, Hafit tombs and LPTs

Modern settlement Analysis of the distance to, and density of, modern settlements suggests that there is no evidence for a spatial relationship between tombs and recent villages, but that there may be an inverse relationship (Figure 5.92). Examining the distance between tombs and recent settlements, statistically the median, mean and standard deviation are significantly larger in the Hafits tombs and LPTs datasets than in the Batinah landscape (Table 5.38). The mean distance for the landscape is just over 4.1km, while for Hafit tombs it is 6.3km and nearly 7.3km for LPTs. There is an even larger difference between the median values: 1.46km for the Batinah; 5.8km for Hafit tombs; and 6.1km for LPTs.

Presented graphically, this weakly inverse spatial relationship becomes clearer (Figure 5.93). Both types of tombs, but LPTs in particular, are disproportionately located in parts of the landscape that are a significant distance from recent settlements, particularly over 8km.

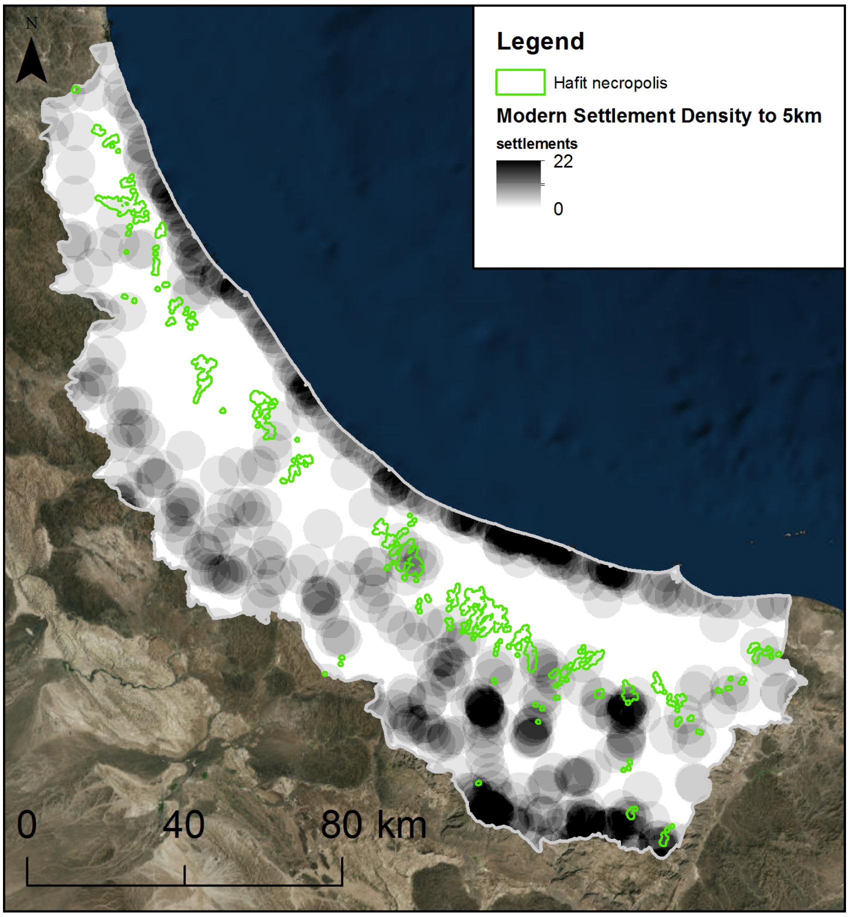


Figure 5.92: The distribution of Hafit Necropolises and 'density of modern settlement' (to 5km)

Table 5.38: Descriptive statistics — 'distance to modern settlement' in landscape, Hafit tombs and LPTs (km)

	Landscape	Hafit	LPTs
Maximum	19.9	19.87	19.31
Minimum	0	0.05	0
Median	1.46	5.78	6.11
Mean	4.14	6.32	7.25
Standard Deviation	3.06	4.54	4.93

'Density of modern settlement' (to 5km) likewise shows a weakly inverse relationship with the tombs. Statistically, the maximum, median, mean and standard deviation of the number of settlements within this distance is significantly smaller in Hafits tombs and LPTs than for the Batinah as a whole (Table 5.39). Once again, while both types demonstrate a similar pattern, it is clearer and stronger in LPTs which on average boast 1.1 villages within 5km, compared to 1.4 for Hafit tombs and 2.7 for the landscape control.

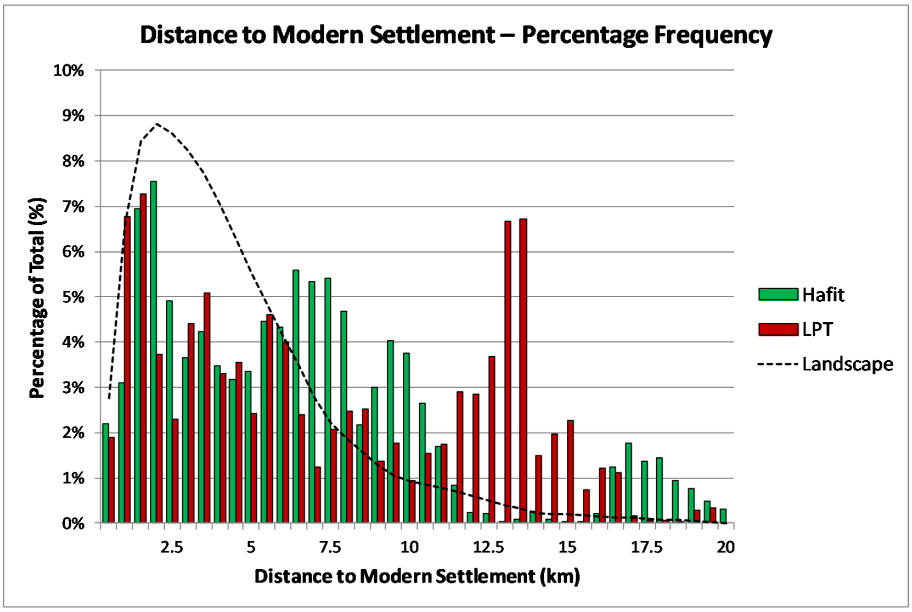


Figure 5.93: Histogram — 'distance to modern settlement' in landscape, Hafit tombs and LPTs

Table 5.39: Descriptive statistics — 'density of modern settlement' (to 5km) in landscape, Hafit tombs and LPTs

	Landscape	Hafit	LPTs
Maximum	22	11	10
Minimum	0	0	0
Median	2	0	0
Mean	2.7	1.4	1.1
Standard Deviation	3.2	2.2	1.6

There is quite a clear contrast in the graphical distribution of the three datasets (Figure 5.94). A much greater proportion of Hafits tombs and LPTs boast no modern settlements within 5km compared to the Batinah as a whole; moreover, generally a smaller proportion of tombs boast villages in their immediate vicinity compared to the landscape control. Only a tiny proportion of tombs are found in areas that support a larger number of recent villages — almost 10% of the Batinah as a whole has between 7 and 22 villages within 5km, but only 3% of Hafit tombs and less than 1% of later structures are located in these areas.

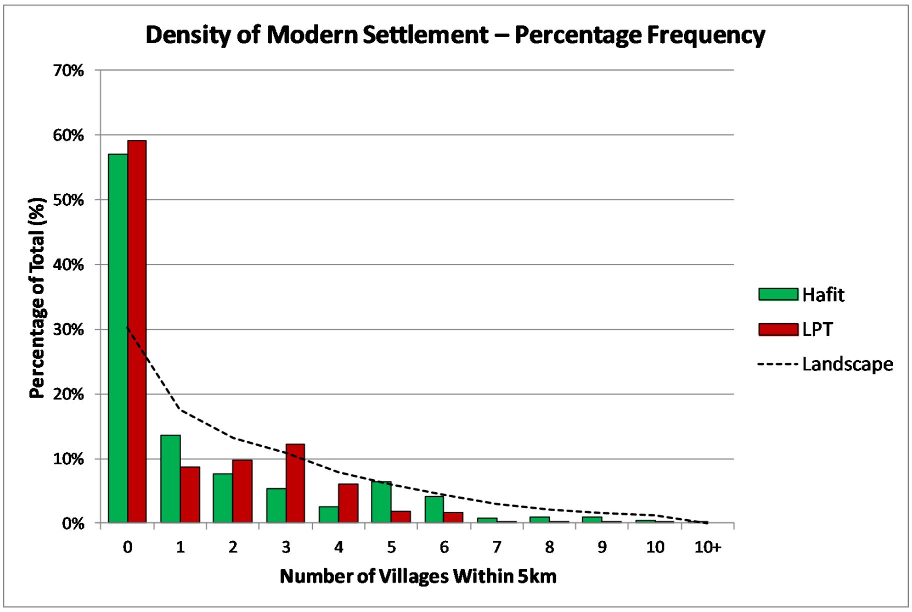


Figure 5.94: Histogram — 'density of modern settlement' (to 5km) in landscape, Hafit tombs and LPTs

5.4.4 Analysis & discussion

GIS analysis of the final B-GE tomb dataset models the distribution of the tombs in the landscape and sheds light on the occupation of the Batinah by the Hafit population. Identical GIS analyses were undertaken on the LPT dataset, providing the comparison of a similar funerary tradition which post-dates the adoption of agriculture.

The spatial distribution of Hafit tombs and LPTs was investigated at short, medium and long range. It was noted during qualitative evaluation that the tombs formed groups at three levels: in small numbers a short distance apart as Clusters; in greater numbers at greater distance as Necropolises; and in very large numbers across considerable distances as Agglomerations. These observations were tested and quantified using a variety of GIS analyses. The simple analysis of overall tomb density revealed a clear contrast between Hafits tombs and LPTs. The Hafit tombs — despite being almost 2,000 fewer in number — cover a wider area and are more sparsely distributed, while the LPTs are concentrated in a significant number of medium-high to very high density hotspots. This may reflect a fundamental difference in settlement patterns in the populations that constructed the tombs.

At a short range of up to 100m it was found that Hafit tombs had far fewer near neighbours than LPTs, and that the majority of these Hafit near neighbour relationships occurred at greater distances of between 60 and 100m. A similar pattern was observed at medium range distances up to 1000m, but more marked as the majority of LPT near neighbours were situated at distances up to 500m. At the longest range analysed, up to

4000m, the disparity continued: there are far fewer Hafit near neighbour relationships than in the LPT dataset; although the proportion of Hafit relationships was fairly stable around the mean, the majority of LPT near neighbours were located at a distance of up to 2000m. These findings demonstrate that the grouping and distribution of Hafit tombs are very different to that of the LPTs, and may well suggest that the populations had fundamentally different subsistence strategies. Hafit tombs are distributed much more thinly across the landscape than LPTs, boasting considerably fewer neighbours at short, medium and long range distances. The disparity between the two funerary datasets lessens with increasing distance, this may suggest that Hafit tombs are scattered thinly but regularly across the landscape while LPTs are concentrated in considerable numbers in discrete groups that are scattered across the landscape at a sizeable distance from one another. This may suggest that the Hafit population was nomadic or semi-nomadic, moving around the landscape and building tombs as they were required, while the later population(s) were less mobile, with tombs concentrated near to more permanent settlement areas or sites (Figure 5.95).

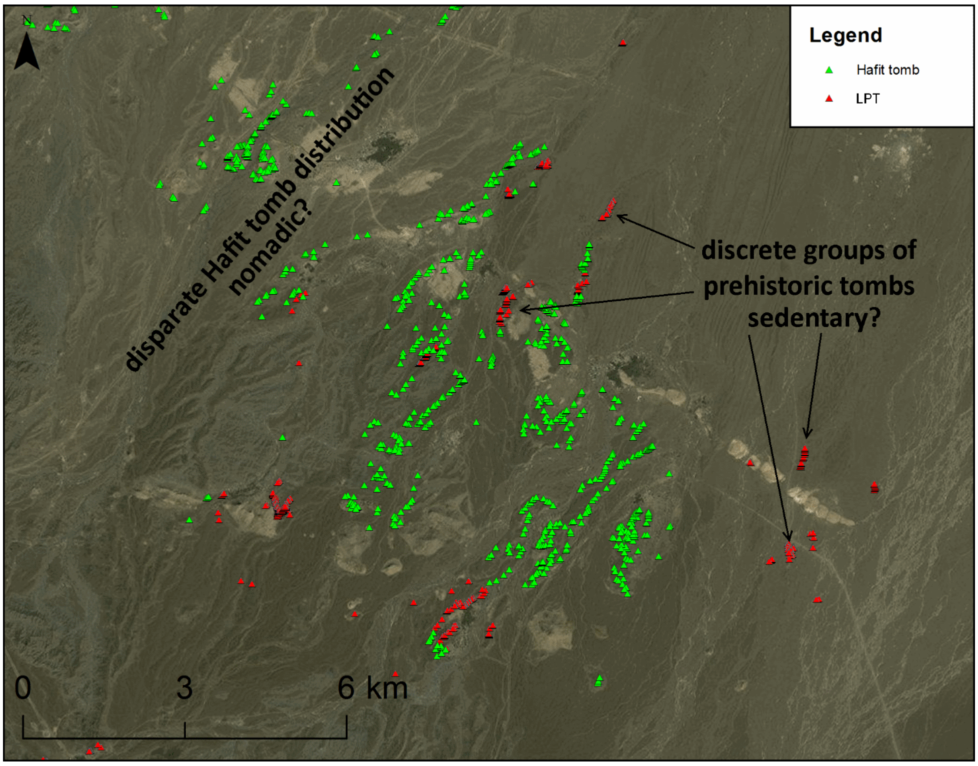


Figure 5.95: The contrasting distribution of disparate Hafit tombs and discrete groups of LPTs — indicating a difference in lifestyle between the populations?

The analysis of tomb spatial distribution demonstrated clear differences in Hafit and LPT Clusters, Necropolises and Agglomerations. Hafit Clusters contain fewer tombs than LPT Clusters; they are more likely to consist of one tomb; their tombs are located at a greater distance from one another; are smaller in surface area; and have a significantly lower tomb density. This suggests that Hafit tombs were only built in close proximity to one another when this was possible, and that Hafit tomb Clusters are not distributed as would be expected in the cemetery of a sedentary population. In contrast, the high number and density of the LPTs suggest that a single Cluster could make up a significant part, or the whole, of a sizeable cemetery that served a significant number of people. One might imply a closer link to a particular place or location in LPTs, and patterns of movement in Hafit tombs. This strengthens the picture of a nomadic or semi-nomadic Hafit lifestyle and less mobility in later populations.

Hafit Necropolises contain fewer tombs than LPT Necropolises, but a greater number of Clusters; they are more likely to consist of a single tomb, but less likely to contain only one Cluster; within Hafit Necropolises tomb Clusters are situated at slightly greater distance from one another, but boast a much larger number of near neighbours; they are larger in surface area and have a significantly lower tomb density compared to LPT Necropolises. The density of tombs and Clusters in LPT Necropolises suggest that these cemeteries were spaces that were used repeatedly by a population for the disposal of their dead. LPT Necropolises are made up of either one or a small number of Clusters — these may represent different social groupings within a population, or may merely reflect limited space in the topography. The sparse but continuous distribution of Hafit tombs and Clusters in large Necropolises may be interpreted as the result of a mobile Hafit population with a wide territorial range that buried their dead as and when it was necessary.

Differences between Hafit and LPT Agglomerations are more subtle. However, there are fewer Hafit Agglomerations than LPT groupings; they are larger in terms of surface area and contain a greater number of Necropolises and tombs at a low density; they are less likely to consist of a single Necropolis, but more likely to contain only one tomb. Once again this follows the same general pattern, with a sparse but continuous distribution of Hafit tombs over a wide area, and more discrete pockets of LPTs. Perhaps the LPT Agglomerations largely link multiple cemeteries and settlements of a related population, while Hafit Agglomerations demarcate all or part of the territory of a single population.

As well as examining the spatial distribution of tombs of the same type, the relationship between Hafit tombs and LPTs was also analysed. LPTs were generally constructed at a short distance from Hafit tombs — the majority of LPTs are found within 1.5km of a Hafit tomb. LPT Clusters, Necropolises and Agglomerations encompass a significant number of Hafit tombs. Moreover, LPTs were built in close proximity to large numbers of Hafit tombs, demonstrating an overlap in the preferred cemetery space of the two populations. The reason for this overlap is unclear. It is possible that both populations were attracted to the same resources, or that the later population(s) felt an ideological connection to the ancient tombs, or that Hafit tombs provided a ready source of building material for LPTs (Figure 5.96). In all likelihood, a combination of these three factors is likely. It is clear from the field evidence that Hafit tombs were both ‘quarried’ and remodelled by the later population(s) — this must be taken into account when analysing the surviving distribution of the Hafit tombs, as it is likely that the later tombs have destroyed or at least obscured a significant number. In particular, it is possible that the high density of LPTs in the north-west of the Batinah obscures the evidence for the Hafit occupation of the area. It is also vitally important to reflect on what this overlapping distribution of Hafit tombs and LPTs means in terms of comparing and contrasting the likely subsistence strategies of the two (or more) populations, this is addressed later (Chapter 5.5).

Figure 5.96: Cell Graves in good condition are quite frequently observed in close proximity to Hafit tombs that are badly destroyed and robbed of stone

While it is worth repeating the cautionary warning to bear in mind the imperfect data quality of the two funerary datasets, as it is not possible to reliably distinguish Hafit tombs and LPTs with complete accuracy, more positively, this also provides further strong evidence for the case that the two can be told apart on satellite imagery (Chapter 4.2). If the process was not generally reliable, and Hafit tombs and LPTs were largely mixed, there would be no difference in the spatial distribution of the two datasets — this is clearly not the case.

The ‘environmental distribution’ analyses reveal much about the Hafit economy and socio-political organisation. The elevation and topography analyses reveal a consistent pattern. In terms of ‘elevation’, tombs demonstrate a clear preference for a narrow band of the Batinah landscape with the majority of both types located between 50 and 250m above sea level. The LPTs showed slightly wider variation in general, but there is a significant number of Hafit outliers located between 650 and 1000m. This preferred area equates to terrain between the flat coastal plains and the Hajar Mountains and their foothills. The analysis of ‘elevation range’ (to 1km) underlines this preference for terrain with some, but not much, variability — no tombs are located on the flattest or most rugged terrain. The examination of ‘Topographic Position Index’ (TPI) demonstrated that Hafit tombs and LPTs are generally located in slightly elevated areas, positioned above much of the surrounding landscape, and that neither tomb types are found in the most elevated or lowly parts of the Batinah. Analysis of 'distance to coast' revealed that the tombs shared a strong, but not proximate, relationship with the sea — the vast majority of all tombs are located between 6 and 34km from the coast. These analyses point to a preference in Hafits tombs and LPTs for the slopes and ridges of low bajada hills, located between the rocky foothills of the Hajar Mountains and the flat coastal plain of the Batinah (Figure 5.97). LPTs have a slightly wider distribution, and are found in greater numbers on the low hills closest to the coast, and towards and within the rocky foothills inland. Despite generally being confined more narrowly to the bajada, a larger minority of Hafit tombs are located in valleys and bowls in the Hajar Mountains.

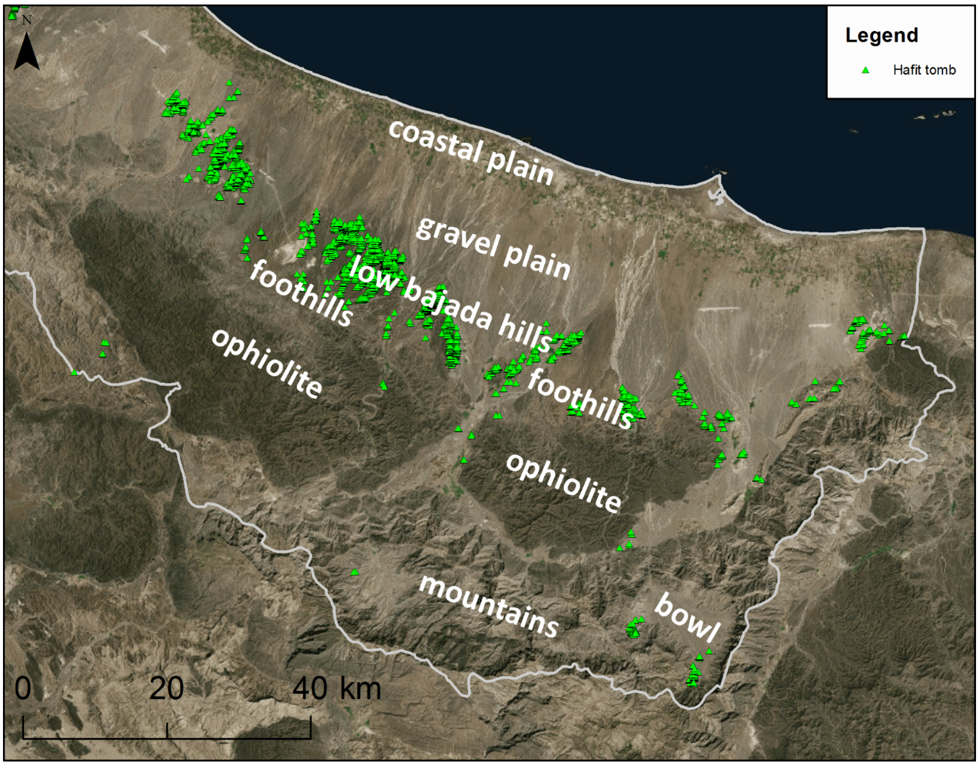


Figure 5.97: Hafit tombs are largely restricted to the low hills of the bajada zone in the southern Batinah

The largely restricted distribution of Hafit tombs in a specific geographical area of the Batinah is highly unusual. In other parts of the northern Oman Peninsula, the distribution of Hafit tombs is distinctly 'vertical' — spread along the course of wadi systems between the mountains and the edge of the plains (see Chapter 1.1.2). In contrast, the Batinah distribution is 'horizontal' — Hafit tombs are spread along the line of low, fluvial, bajada hills, running parallel to the mountains and the coastline. The Hafit relationship with the coast is difficult to interpret — the tombs and the living population may have purposefully been located at a distance so that the sea was accessible for exploitation, or the coast may just happen to be situated at a fairly constant distance from preferred Hafit territory as an accident of Batinah geography. The similar, if slightly wider, distribution of the LPTs suggests that the later population(s) occupied a similar area to the Hafit population.

As in other regions, the hydrology of the Batinah appears to have had a strong influence on the distribution of Hafit tombs. The vast majority of tomb are found at a short distance from a wadi, and a disproportionately high number are located within 1km of a sizeable watercourse that drains a large area. It is natural that the Hafit population would occupy areas of the landscape in which water was readily available; within the bajada zone the watercourses drain the largest possible area, and therefore hold large volumes of water before it sinks into the gravels of the plains. However, the lack of Hafit tombs further upstream in the rocky foothills of the Hajar Mountains — as they are in other regions — is unusual, as here wadis are of considerable size and their flows are concentrated in a narrower channel. It is possible that the bajada was more attractive as it provided access to water and other important resources that were unavailable further upstream. LPTs exhibit a similar, slightly weaker relationship with wadis, demonstrating that access to water was as vital in later times.

The analysis of the three geological variables may illuminate Hafit economic and subsistence strategies. The strongest relationship observed between Hafit tombs and their environment was with the discontinuous ridge of pale buff Tertiary rock that runs roughly parallel to the line of the coast and the mountains. The number of tombs that are located in close proximity to — mostly just inland of — this geological formation is completely out of proportion to the space that it occupies within the landscape. Half of all Hafit tombs are located within 2.7km of the feature, an area that makes up less than 17% of the Batinah as a whole. This relationship is difficult to interpret. It is possible that, as the ridge runs through the bajada zone, it was valued only as a source of building stone and an elevated position on which to build tombs. A more likely explanation, given the strength of the relationship, is that this Tertiary formation influenced the hydrology of the area. The ridge may act as an aquiclude — a semi-subterranean natural dam — that forces groundwater towards the surface. The possibility of this geological feature having this effect on the local hydrology was first postulated by a Durham University survey in the 1980s, and has been supported by more recent geomorphological research. The Tertiary material may be damming alluvial and fluvial water flows and cause a localised rise in groundwater at the base of the outcrops, forming pools of water as it is forced from within or between the gravel beds to the surface (Anderson 1984: 9, figure 2; Ash Parton pers. comm.). As annual average rainfall was probably greater during the Hafit period — it predates the 4,200 B.P. aridification event (Parker, Goudie, et al. 2006) — it is likely that these freshwater bodies would have extended water availability during the year. While such pools are not widely apparent in today's dryer conditions, a study of groundwater depth in the southern Batinah demonstrates that within the gravels, water is closest to the surface behind the larger Tertiary outcrops (Lakey et al. 1995: see Figure 5.98). As an excellent — and possibly perennial — supply of water it explains why such a large proportion of Hafit tombs are located on, around and behind this discontinuous Tertiary ridge. Although not apparent from the results of the analysis, the relationship between Hafit tomb distribution and the Tertiary ridge is much weaker in the northernmost part of the Batinah where there are no outcrops, the fact that in these areas the tombs' relationship with wadis is much stronger supports the theory that water is the key factor. While still notable, the relationship between this ridge and the LPTs is much weaker; this strengthens the aquiclude theory as these tombs post-date the 4,200 B.P. aridification event — with lower rainfall, water may not have pooled behind the ridge to the same extent.

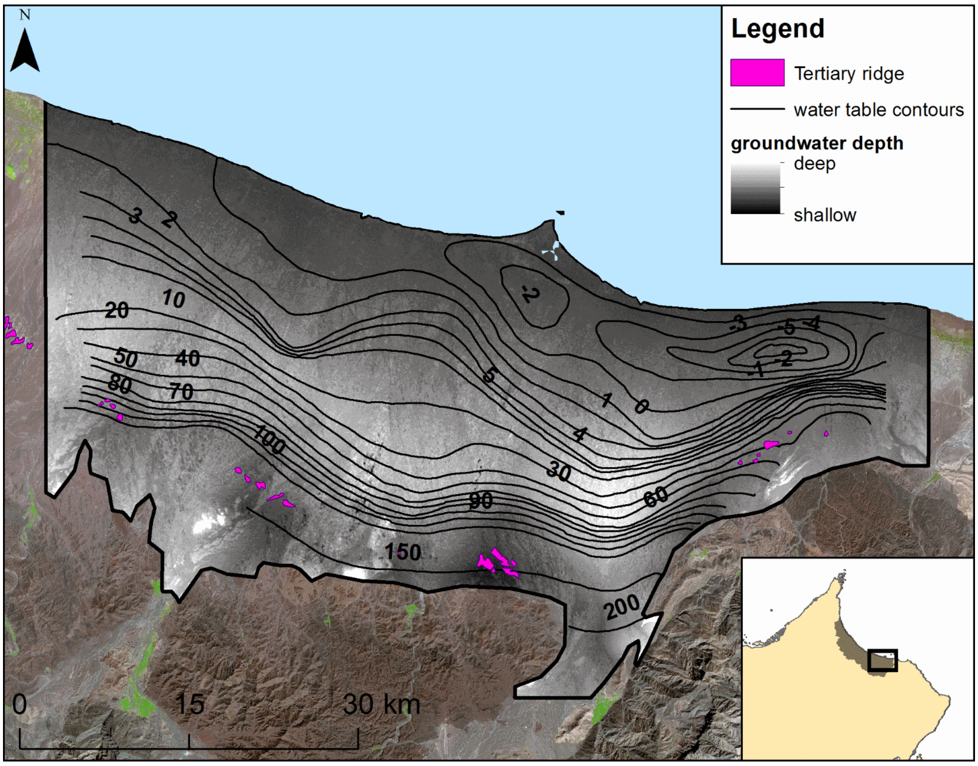


Figure 5.98: Groundwater depth in the eastern part of the Batinah plain — hydrological model made available by Richard Lakey, method described in Lakey et al. (1995)

Hafit tombs also demonstrate strong spatial correlation with copper ore (Figure 5.99). Despite the plentiful distribution of copper ore in the Batinah, Hafit tombs are located much closer to ore sources than the landscape control. 80% of Hafit tombs are found within 8km, an area that makes up just over half of the Batinah region as a whole. The case for Hafit copper exploitation in the Batinah is especially strong because the geological context of copper ore — located within the Cretaceous ophiolite — is generally unfavourable for settlement, with very few Hafit tombs or modern settlements being found in these areas. Interestingly, the relationship between Hafit tombs and copper ore is stronger than that between LPTs and copper ore — despite the fact that the later tombs date to some time within the Bronze and Iron Ages, when copper was still very much in widespread use and, judging by the volumes of slag that have been discovered, was exploited on a large scale (Hauptmann 1985). However, it is possible that the correlation between the the distribution of Hafit tombs and copper ore sources is a geological coincidence. Hafit tombs clearly favour the low bajada hills, geologically the Batinah bajada zone is adjacent to the ophiolite foothills where copper minerals are found — so the Hafit population may have had no idea that they built their tombs in areas located a modest distance from copper ore sources. However, the strength of the relationship suggests that the relationship between Hafit tombs and copper ore is more than coincidental.

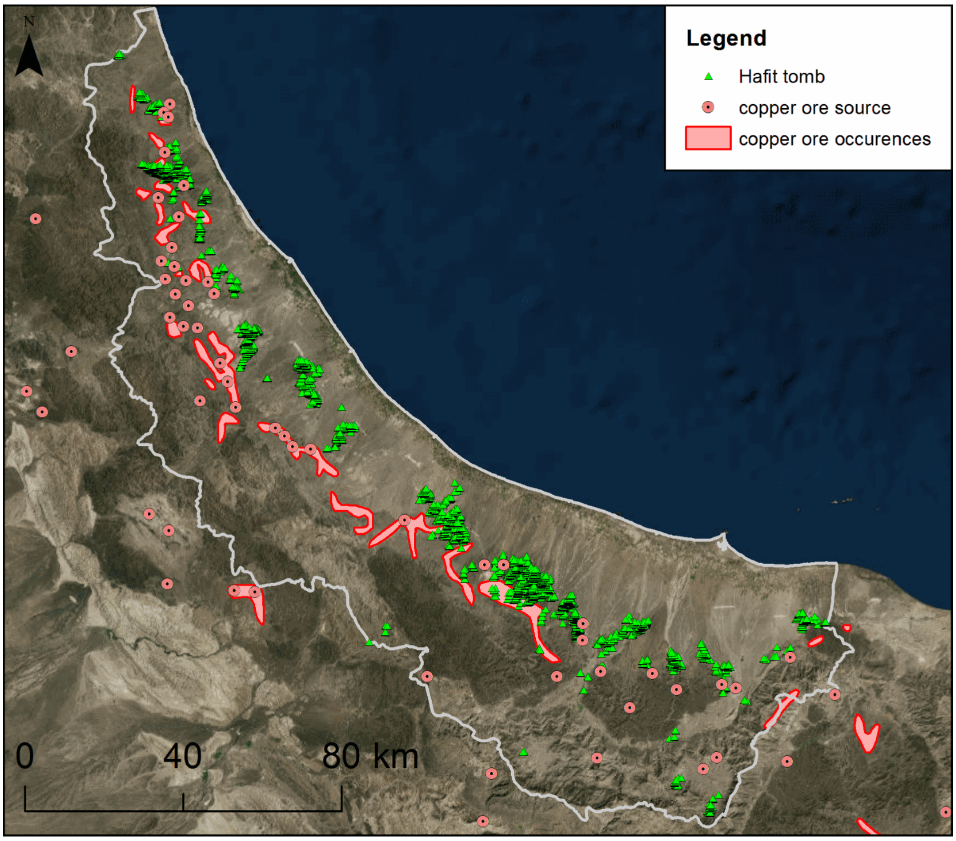


Figure 5.99: Spatial correlation between Hafit tombs and copper ore in the Batinah

The areas that boast large numbers of Hafit tombs generally do not overlap with those settled by the recent Batinah population. The tombs exhibit a weakly inverse relationship with modern settlement — compared to the landscape as a whole, they are found in areas that are more distant from recent towns and villages than the average, and where very few settlements are found within 5km. The obvious interpretation of this evidence is that Hafit society had fundamentally different subsistence and economic strategies to the traditional Batinah population. Assuming that they did not bury their dead at a great distance from where they lived, it suggests that the Hafit population exploited neither the low water table and suitable silts of the coast, nor the run-off water and silts of the mountains and rocky foothills to grow crops. Rather, their presence in between these areas, where water is present but soil is not, strongly suggests that they were not farmers, or at least that they did not rely on agriculture for subsistence. It is more likely that they were independent pastoralists, that perhaps supplemented their diet from the nearby, rich marine environment. However, the major problem with this interpretation is that the LPTs show a very similar distribution pattern, and these tombs date to sometime after the introduction of agriculture to the northern Oman Peninsula. If horticulture was not practical where most of the LPTs are situated, then the population that built them most also not have practised arable agriculture. This and other issues raised in the interpretation of the GIS analysis are discussed in greater detail in the following section.

5.5 Discussion

Thousands of Hafit tombs and LPTs have been mapped and analysed over the course of this research, but what does this archaeological data reveal about the nature of Hafit society? As the majority of Hafit tombs are to be found in the mid-Batinah bajada zone, the simplest explanation would be that the majority of the living Hafit population occupied this area. It is possible that Hafit dead were transported significant distances to favoured cemetery areas. There is evidence for the secondary burial of decomposing and skeletal remains during the Neolithic in the northern Oman Peninsula (Kutterer 2010; de Beauclair 2008; Gaultier et al. 2005), and although no similar claims have been made in analyses of Hafit human bone assemblages (see Chapter 1.1.2), this possibility cannot be entirely ruled out, although for the moment the more likely equivalence between the occupation of the landscape by the living and dead populations will be considered. The Batinah concentration of Hafit tombs in a small geographical zone is not mirrored in other regions of the northern Oman Peninsula (e.g. Deadman 2012a; Giraud and Cleuziou 2009), suggesting that there was something unique about the geography or pattern of human exploitation of the Batinah. If it does form an aquiclude, the Tertiary ridge that runs through the bajada might well explain this anomalous distribution; Hafit tombs show an extremely strong spatial relationship with this geological feature. If water was perennially available very close to ground level or pooled above the surface behind rock outcrops, then the area would be extremely attractive to the Hafit population, especially as during the Hafit period the northern Oman Peninsula received greater rainfall. The lack of suitable soil sediments for farming in the bajada — which are concentrated near the end of the plain where modern settlement is densest — strongly suggests that Hafit subsistence did not rely on arable agriculture. Hafit occupation of this area is more consistent with pastoralism — taking advantage of the water and rich grazing available near the aquiclude to provide for herd animals. The case for some form of Hafit nomadic pastoralism in the Batinah is supported by the continuous, low-density distribution of Hafit tombs across the landscape. Hafit Clusters contain few tombs and are found a substantial distance apart. This tomb distribution is inconsistent with a sedentary population living in permanent settlements, but accords better with a nomadic or semi-nomadic population moving around a territorial range — perhaps centred on the rich hydrological and grazing resources of the aquiclude — and interring their dead on the nearest suitable high ground as and when it was necessary. If this is accurate then the Batinah Hafit population is likely to have been dispersed as independently mobile household groups consisting of extended families — the standard model for nomadic pastoralists throughout the northern Oman Peninsula (e.g. Lancaster and Lancaster 2002: 243; Chatty 1990: 341; Birks 1976: 9).

The Tertiary ridge and aquiclude is absent in the *wilayat* of Shinas and Liwa, north of Sohar, and far fewer Hafit tombs are present in these areas. Hafit tomb distribution changes in this part of the Batinah — tombs closely hug the channels of larger wadis and follow their course over greater distances than elsewhere in the region (Figure 5.100). This underlines the significance of the aquiclude: where the Tertiary ridge does not outcrop, the tombs suggest that the Hafit population was smaller and more reliant on wadis — with these watercourses dictating the Hafit occupation of the landscape — as in other parts of the northern Oman Peninsula (e.g. Deadman 2014; 2012a). There is still a relationship between Hafit tombs and wadi channels in the southern part of the Batinah, but almost always behind the line of the Tertiary ridge, and much more loosely than in the north.

However, for the case for Hafit nomadic pastoralism to be compelling, the similar distribution of the LPTs must be explained. Although it is not currently possible to accurately date these tombs, the Iron Age is the best candidate for Cell Graves and Honeycomb Tombs (Chapter 4.2.1) — and all were constructed after the Early Bronze Age, and therefore post-date the adoption of the 'oasian' agricultural model in the northern Oman Peninsula (Potts 1994: 263). If a large proportion of the LPT-building population(s) was drawn to the same geographic area that had been heavily occupied during the Hafit period then either: the region could support arable agriculture, undermining the case for Hafit pastoralism; or the area was not farmed in these periods but was again exploited by pastoralists. The spatial distribution of the LPTs is significantly different to that of the Hafit tombs — they are clustered in discrete groups with greater distances between them; this may suggest that the two populations were

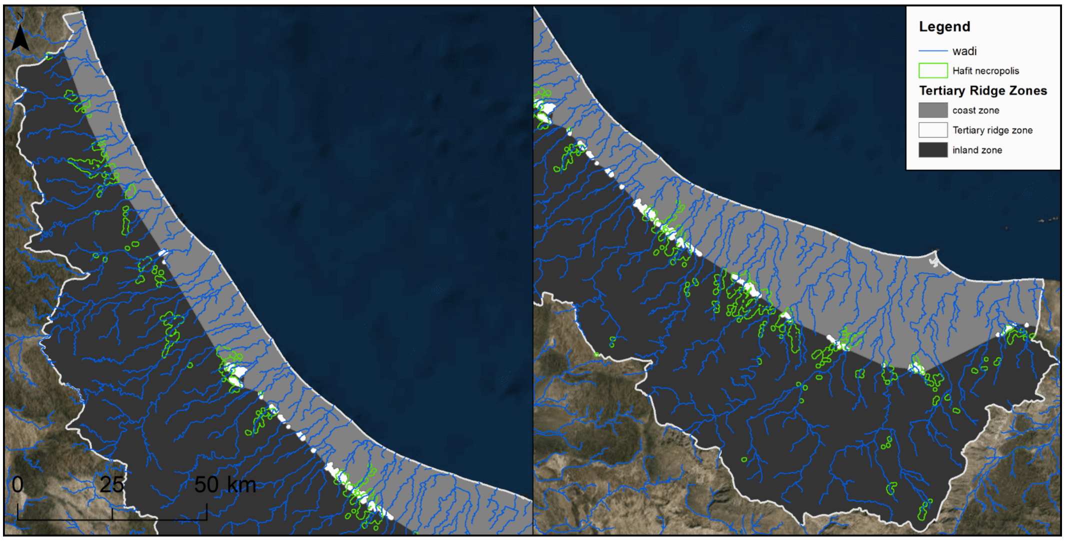


Figure 5.100: Contrasting Hafit tomb-hydrology relationship in the northwest of the Batinah and the central and southeastern parts

mobile to a different extent and practised different subsistence strategies. However, although there is a marked difference in the spatial distribution of the tombs, the LPT distribution is still not consistent with what would be expected of the cemeteries of a sedentary population. Although less markedly than Hafit tombs, LPTs are clustered in fairly low numbers, with significant distances between them. An appropriate parallel for the LPT population(s) may be made with modern lowland *shawawi* — pastoralists who are reliant on farming villages, and who often own their own palm gardens in these communities (Birks 1976). Modern desert bedouin have a similar relationship with sedentary communities (Chatty 1996; 1990). It is not unlikely that the later population(s) that inhabited the bajada zone were pastoralists that moved seasonally, and had favoured camps in the bajada, but were reliant on or even formed part of inland or coastal sedentary populations for at least part of the year. There is clear evidence for sizeable prehistoric settlements in these areas of the Batinah (Kennet, al-Jahwari, Deadman, Brown, et al. 2016; Kennet, al-Jahwari, Deadman, Mortimer, et al. 2015). However, although the LPT distribution is slightly wider than the Hafit distribution, the tombs are still concentrated in a similar band, where sedentary agriculture is impractical. The only explanation for this is that the inland and coastal sedentary communities must have had different funerary practices. There is no evidence for a sedentary Hafit population on the Batinah, therefore this may explain the contrasting distribution of the two tomb types — both are the result of pastoralists occupying the same area, but the Hafit population was more mobile and independent, while the later population was dependent on, or made up a segment of, sedentary agricultural communities living in other areas. An alternative explanation is that the LPTs may date to one of the lengthy phases of prehistory for which there is little evidence for sedentary occupation, during which the population, or large parts of it, may have turned to an independent nomadic pastoralist lifestyle (al-Jahwari 2013b: 164–165, 176–177; Cleuziou 1981). Regardless of the precise nature of this later economy the presence and distribution of LPTs does not undermine the case for the prevalence of some form of independent nomadic pastoralism during the Hafit period.

Hafit occupation of the Batinah appears to have relied on nomadic pastoralism and the rich grazing and water resources surrounding the Tertiary rock aquiclude that runs through the bajada outwash plain, and large wadi channels in the northern part of the Batinah where the aquiclude is absent. However, other resources and areas also appear to have been significant to Hafit society in the Batinah. The spatial relationship between Hafit tombs and copper ore sources is strong, with more than half of tombs located within 5km of copper ore, compared to 14.6km for the Batinah landscape as a whole. It appears that the distribution of copper ore played some role in dictating areas that were occupied by the Hafit population, strongly suggesting that copper exploitation was highly significant in Batinah Hafit society. If copper was mined, smelted and worked during the Hafit period, then this is likely to have been carried out on a small scale, perhaps as a cottage industry. It seems improbable that nomadic herders, sparsely occupying the landscape, exploited copper intensively; while Hafit tombs are found at relatively close range to copper ore sources, they are rarely found very close, and never in such numbers or density to suggest permanent or full-time metallurgical exploitation. Rather the tomb distribution suggests that copper was exploited at a low level, perhaps mostly for domestic consumption and local trade, although this does not downplay the significance of copper in Hafit society.

It must be acknowledged that there is some degree of circularity in the case for a bajada-based Hafit occupation of the Batinah — that the living population occupied this area because this was where they were buried. However, there is good reason for this as Hafit tomb distribution elsewhere in the northern Oman peninsula is much broader, spread over a much wider range of environments from low gravel hills bordering the plains, to the rockier foothills and the more elevated uplands (e.g. Deadman 2012a; al-Jahwari 2013b). It would be strange for the living Hafit population to be inhabiting a similar range of environments in a similar fashion on the Batinah and yet restrict their burial areas to the bajada, especially as there are plenty of suitable elevated areas and good availability of stone building material in the foothills and uplands. However, the relationship between the Hafit population and the coast is more difficult to interpret as here such resources are not available. Hafit tombs are consistently found at a low to middle distance from the sea, with the vast majority located between 6 and 34km away — between an hour and a day's walking distance. Thus, the absence of Hafit tombs does not necessarily prove that the Hafit population did not occupy or exploit the coast. A number of interpretations present themselves, either: 1) the Hafit population did not exploit the coast; 2) the Hafit population occasionally exploited the coast but from their permanent territory in the bajada hills and spending relatively little time there; 3) that they exploited and occupied the coast intensively, but transported and interred their dead in cemeteries in the bajada hills; or 4) they exploited and occupied the coast intensively, but disposed of their dead using a different means. The Batinah coast, despite a lack of suitable natural ports, is very rich in fish (Wilkinson 1977: 8), and it seems unlikely that this rich, nearby resource was ignored by the Hafit population. Especially as virtually all known sites from earlier in the 4th millennium BC are restricted to coastal areas (Charpentier 2008: 108–109; Uerpmann 2003: 76–78); and Hafit occupation and exploitation of the coast is well attested in other regions (Salvatori 2001: e.g. Giraud and Cleuziou 2009). Analysis of Hafit tomb distribution cannot ascertain the relationship between the Batinah Hafit population and the sea, but given that the vast majority of tombs are located within a day's walk from the coast, the richness of the resources available, and the known preference for coastal areas in the preceding period and in other contemporary Hafit communities, it seems unlikely that the population did not exploit the area at least to some extent.

There are other, less convincing, possibilities that might explain the Batinah Band that nonetheless merit exploration. It may be that Hafit cemeteries were established in the bajada not because this was where the living population spent most of their time, but because they provided the best possible terrain for their purpose. The low hills in the otherwise generally flat bajada terrain offer excellent visibility and a ready supply of stone for tomb construction to advertise ownership or access rights to the land. However, it seems strange that ostentatious cemeteries would be located in areas that were little used by the population, especially when the rocky foothills and uplands further inland offer in many ways a much more dramatic landscape for Hafit tomb placement that was certainly utilised in other parts of the northern Oman Peninsula (e.g. Deadman and al-Jahwari 2016). An alternate but possibly complementary explanation is that the bajada made a convenient cemetery space that served to link two areas that were critical to Hafit subsistence — the coast and the rockier foothills and uplands. The Batinah band may have linked either related Hafit communities either side of the bajada with a shared cemetery space in-between, or environmental zones that were exploited by the same population at different points in the year. While this explanation is plausible, it would also suggest that the Batinah population disposed of their dead in a fundamentally different way to the rest of the Hafit population of the northern Oman Peninsula (e.g. Deadman 2012a), by so markedly differentiating between cemetery areas and occupation areas. While these alternatives should be borne in mind, the present author finds the Tertiary aquiclude hypothesis, from which the Hafit population could also exploit both inland resources and the coast, more convincing.

As well as offering rich nutritional resources, the coast also offers excellent opportunities for trade and exchange. In terms of local trade, as the Hafit population lived in such close proximity to the sea even relatively short journeys up or down the coast may have been quicker by boat. Local trade and exchange may have included preserved terrestrial and marine food goods, simple beads and jewellery which are found in great numbers — and very similar in their style across the northern Oman Peninsula (Chapter 1.1.2) — in Hafit tombs, as well as the fruits of a small-scale domestic copper industry. While the importance of local trade and exchange should not be underestimated, especially given the uniformity of the Hafit material culture across the northern Oman Peninsula, international trade has huge potential for shaping the nature and development of Hafit society in the Batinah. The Hafit period was first defined by the small painted carinated Mesopotamian jars recovered from Hafit tombs — as well as lesser numbers of other exotic goods — that date from the Jemdet Nasr to Early Dynastic periods (During-Caspers 1971; Potts 1986). The dearth of mineral resources in Mesopotamia and the very extensive distribution of copper ore in the Batinah — the major deposits in the northern Oman Peninsula — show clear potential for strong trade links between the two areas during the Hafit period. Isotope analysis of Mesopotamian copper objects has demonstrated that a significant minority have a chemical signature that is consistent with Omani copper sources. Numbers peak in the Umm an-Nar period but above 20% of artefacts tested from the start of the Hafit period also boast this signature (Begemann et al. 2010: 159, Table 5). The sea may well have provided access to lucrative trade — direct or indirect — with Mesopotamia, with domestically produced copper being exchanged for small carinated jars, and their original contents, as well as small quantities of other luxury items including beads (Potts 1986: 131–132). The copper trade may provide the final piece of the explanation for the banded distribution of Hafit tombs. The aquiclude provided sufficient water and grazing resources to support a population of small dispersed family bands of Hafit nomadic pastoralists; in their continual movements they headed inland to the copper deposits in the ophiolite and a similarly short distance to the coast where their pastoralist diet was supplemented with marine resources and where they were able to trade simply-worked copper and other goods locally and internationally (Figure 5.101). It is possible, if conjectural, that this followed some seasonal pattern — perhaps defined by climate or marine systems that governed fish stocks and sailing conditions (cf. Cleuziou and Tosi 2000: 41).

Evidence for local trade and exchange may be apparent from the distribution of outlying Hafit tombs. Very small numbers of lone Hafit tombs or isolated clusters are found a long way south of the main band. These tombs deeply penetrate the valleys and eroded bowls of the Hajar Mountains. It is possible that they represent very isolated communities living a great distance from each other and the major population to the

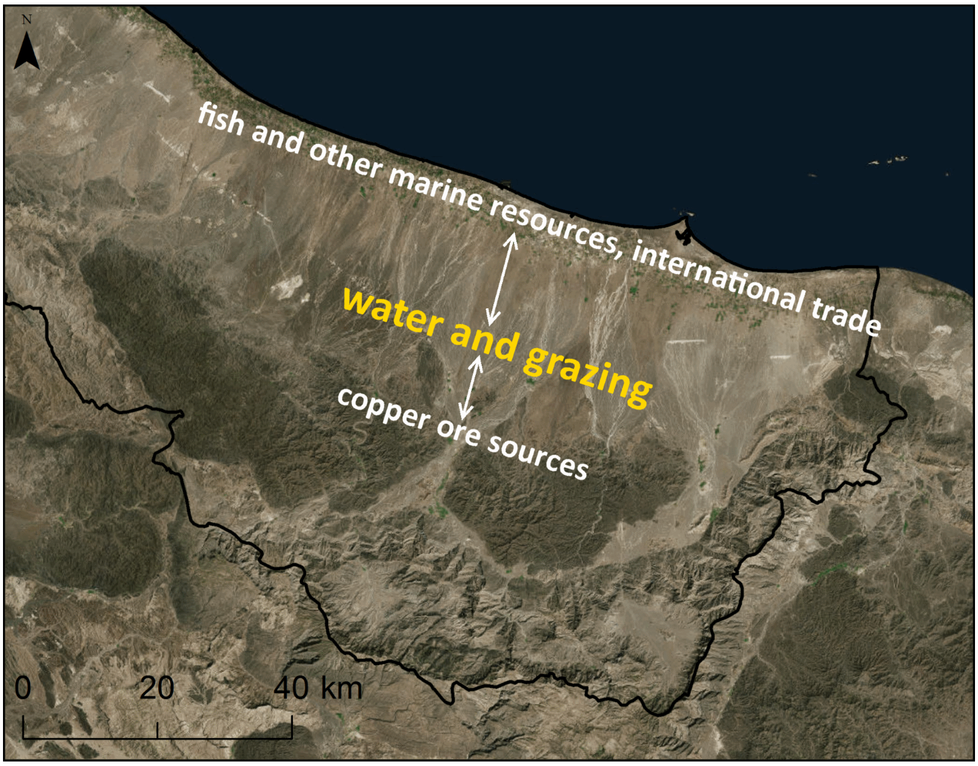


Figure 5.101: Possible movements of the Hafit population from their base in the bajada for coastal and inland resources

north, but the small number of tombs dictate that these must have been short-lived communities with a tiny population. Alternatively, these tombs may testify to a small subset of the bajada Hafit population moving through the mountains towards Hafit communities in other regions to the southwest of the Hajar Mountains. The Hafit tombs run along major mountain wadis that provide natural pathways through the difficult terrain that would eventually emerge heading towards other major tomb concentrations (Figure 5.102). These isolated tombs may testify to the existence of local trade and exchange between the Batinah Hafit population and other major contemporary communities in modern-day Dhahirah, Dakhiliyah, Buraimi and Sharqiyah.

Hafit tomb distribution has the potential to provide insight into the subsistence and economic strategies of the Hafit population, and to illuminate the socio-political organisation of Hafit society. It is likely that groups of related, family bands shared territory, bordered by land belonging to other groups. However, the 'horizontal', banded distribution of Hafit tombs makes it difficult to delineate likely territorial borders — unlike elsewhere in the peninsula where wadi basins naturally divide the landscape (Chapter 4; Deadman 2012a). However, although covering large areas, Hafit tomb distribution is not continuously uniform — Necropolises and Agglomerations may be defined with significant distances between them. Agglomerations may represent part or whole territories — they average ~70 sq-km, but cover up to 360 sq-km — that are

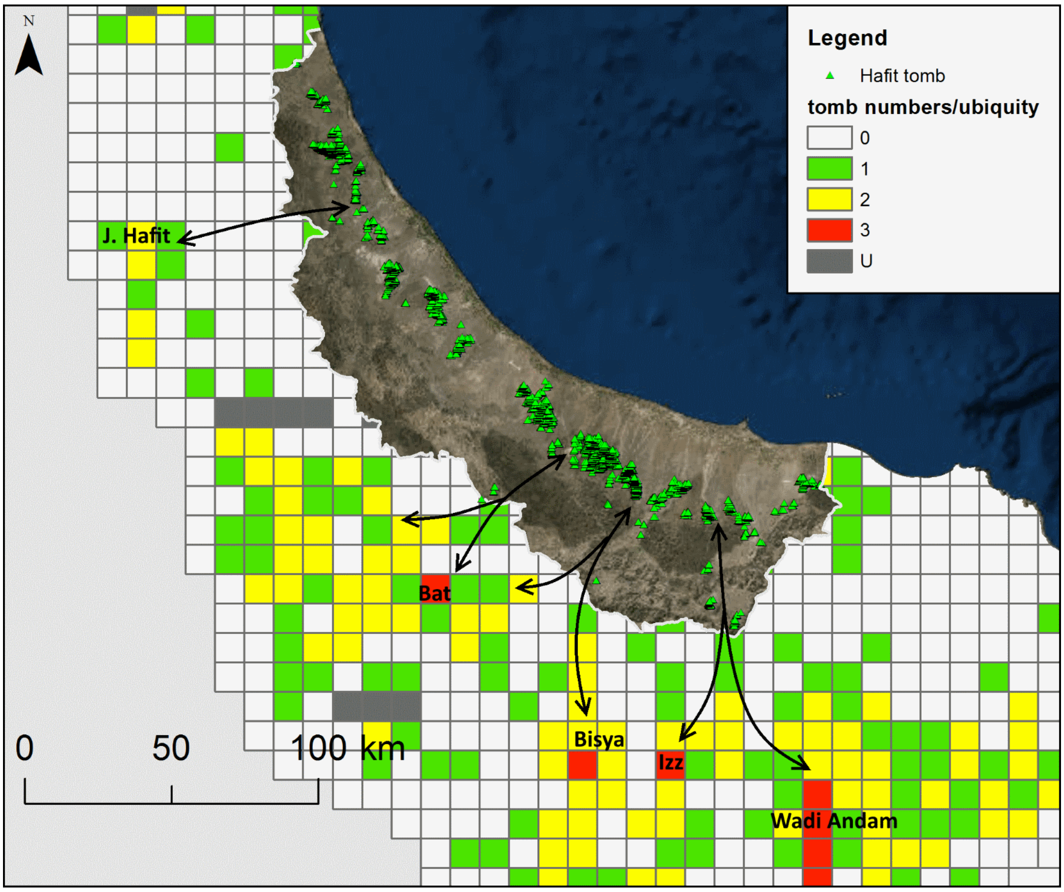


Figure 5.102: Possible local trade and exchange routes between the Batinah Hafit population and other groups on the other side of the Hajar Mountains

situated a considerable distance from the tombs of the next Agglomeration and territory. Frequently, Hafit tomb Agglomerations overlap with the location of Tertiary aquiclude outcrops — hotspots of water and grazing which may have formed the focus of individual territories (Figure 5.103). The Tertiary outcrops are not continuous — distances of between 5 and 30km lie between them, providing natural boundaries. The Hafit population is likely to have varied between these territories, as the density of the Hafit tombs does — tombs are most numerous in the *wilayat* of Suwaiq, Khaburah and Saham, where the Tertiary outcrops are longest, largest and tallest, and therefore form the most effective aquicludes that collect the most water. Wherever the precise boundaries lie, territoriality is clearly expressed in the tombs of the Batinah — as elsewhere in the Oman Peninsula (cf. al-Jahwari 2013a; Deadman 2012a; Giraud 2010; Cleuziou 2002a). Tombs were built on elevated areas in the bajada — low fluvial hills and the Tertiary outcrops. In some areas — observed in the field and in satellite imagery — extra effort was made in selecting building material to make tombs stand out in the landscape, often contrasting darkly patinated wadi cobbles with pale buff angular bedrock. This proclamation of rights over land would be particularly important for a nomadic population that could not be present to claim or defend every part of their territory in person.

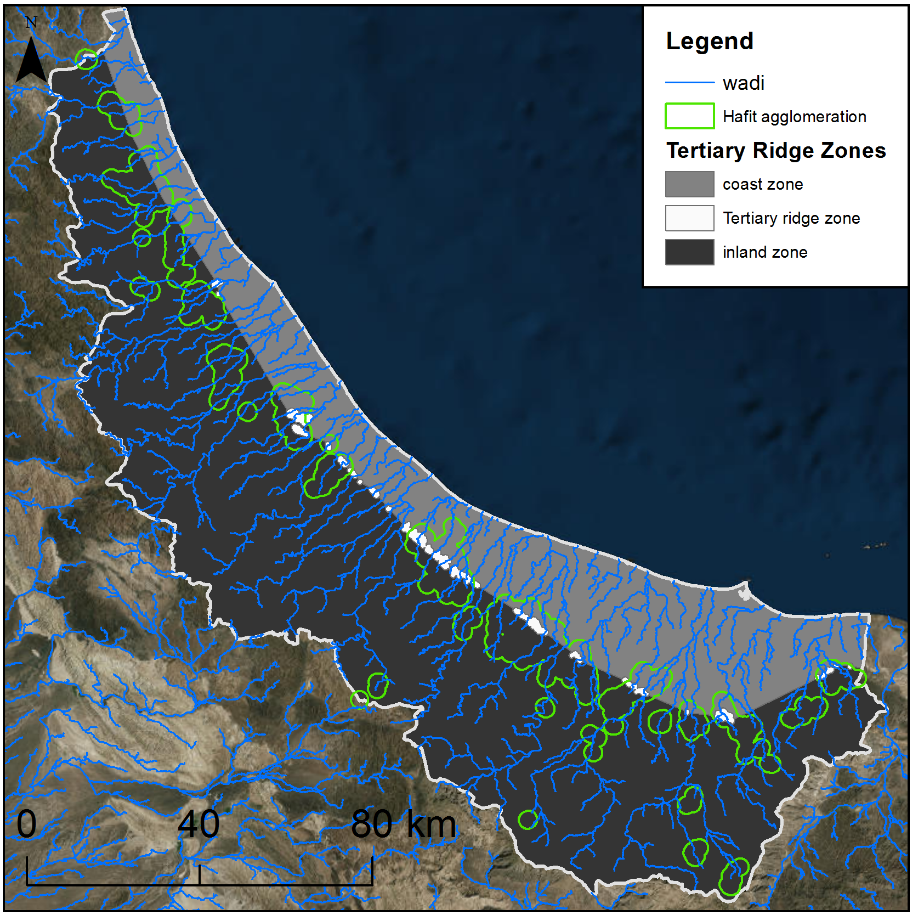


Figure 5.103: Possible Hafit territories centred around Tertiary outcrops in the central and southeastern Batinah, and large wadis in the northwest of the region

While analysis of the results of the B-GE survey are clearly invaluable in shedding light on the economy and social and political organisation of the Hafit population of the Batinah, some caution must be expressed due to the nature of the data. While ground-truthing fieldwork and the distinctive distributions of the Hafit and LPT datasets provide a good case for the reliability of the remote sensing based method, the process of distinguishing between Hafit tombs and similar, later stone funerary structures is not perfect (Chapter 4.2). It should also be borne in mind that LPT cemeteries may well obscure, or render invisible, evidence for older Hafit tomb distribution. While there is more than enough evidence for the accuracy of the two datasets to justify the GIS analysis approach taken to shed light on Hafit society, the data itself and some of the conclusions may need to be revisited and updated in the future as the survey and excavation of more Batinah tombs is carried out and published.

5.6 Conclusion

The aim of this chapter was to map the Hafit funerary archaeology of the Batinah and explore the nature of Hafit society in the region. This was to be achieved through making use of the free, high-resolution satellite imagery and software of Google Earth to mark the location of every visible Hafit tomb in the Batinah. Any Later Prehistoric Tombs (LPTs) that could be mistaken for Hafit tombs were also marked. The distribution of the Hafit tombs was modelled with GIS in order to provide insight into where and how the population that built the tombs occupied and utilised the Batinah landscape. The results of the survey and GIS analysis were then interpreted in order to shed light on the possible nature of Hafit society in the region.

Firstly, a trial survey was carried out on six 10km transects across the length of the Batinah in order to test the B-GE survey methods and to collect information on LPTs that could confuse data collection. During the B-GE transect survey more than 2,700 possible Hafit tombs were located as well as 15 possible LPT cemeteries; tombs from twenty-one sites were examined and recorded in the field, and the transects were traversed to ascertain whether Hafit cemeteries had been missed during the survey. Ground-truthing results suggested that only a tiny number of small Hafit cemeteries had not been located on the satellite imagery, but that distinguishing Hafit tombs from LPTs was more problematic. The vast majority of LPTs recorded in the field proved to be Cell Graves, with a much smaller number of Honeycomb Tombs, and other types also being observed.

Having trialled the methodology and collected data on the LPTs of the Batinah, the survey was expanded to cover the whole region. A preliminary phase, the 1km B-GE survey, marked the location of all visible Hafits tombs and LPTs, and the second stage, the 12" B-GE survey, was carried out at higher magnification to distinguish the Hafit tombs from LPTs using a reference collection of satellite imagery. The final results of the B-GE survey identified over 6,000 Hafit tombs and nearly 8,500 LPTs. Ground-truthing results suggest that barring structures in the very worst condition, Hafit tombs can be accurately distinguished from LPTs.

GIS analysis was utilised in order to model the distribution of the Hafit tomb and LPT datasets: their spatial distribution, analysing the relationship between tombs; and their environmental distribution, examining tomb location in their natural and anthropogenic landscape. It was demonstrated that the spatial distribution of Hafit tombs was significantly different to the LPTs: the former showing a lower density and a more continuous distribution, while the latter cluster in tight groups with significant distances between them. Environmental analyses demonstrated that Hafit tombs are concentrated almost entirely in the bajada outwash zone of the Batinah, and that the tombs show a strong link to a discontinuous ridge of Tertiary rock running through this area, and with sources of copper ore. Hafit tombs also exhibited a relationship with wadi channels, and an inverse relationship with modern settlement areas. The LPTs boasted a similar, but generally fainter, pattern — showing much weaker relationships with copper and the Tertiary ridge, and a generally wider distribution.

Interpretation of these results suggest that the vast majority of the Hafit population occupied the bajada outwash zone. This is so far unique in the northern Oman Peninsula, which may suggest that it is the result of unique Batinah geography. An excellent candidate is the discontinuous ridge of Tertiary rock that runs parallel to the coast and the mountains several kilometres out from the foothills — this may have acted as an aquiclude during the Hafit period when there was more rain, causing water flowing from the mountains to collect behind it and pool above the surface. This may have formed a perennial source of water that was so reliable that Hafit landscape occupation of the Batinah centred around it. A lack of suitable soil sediments in the bajada suggests that the Hafit population were pastoralists exploiting grazing; the sparse, low-density and continuous distribution of the tombs indicates that they were nomadic — a dispersed population living in small family bands. In the two northernmost Batinah *wilayat* there are no outcrops of Tertiary material. Here there are fewer Hafit tombs and they show a much closer relationship with the major wadi channels — demonstrating the importance of the aquiclude where it is present, and the necessity of adopting a different strategy where it is not. The strong relationship between the distribution of Hafit tombs and copper ore suggests that the metal was exploited during the Hafit period, but the fact that tombs do not intensively cluster around mineral sources suggests a low-intensity, non-specialist and probably domestic exploitation of copper. The strong, but not proximate, relationship between Hafit tombs and the coast — confused by the impossibility of constructing tombs on the coastal plains — suggests that the Hafit population did carry out at least limited exploitation of the rich resources that were usually less than a day's walk away. This combination of proximity to coast and copper may hint at the existence of local trade and exchange, while evidence from outside the Batinah strongly supports that the region was involved in international trade with Mesopotamia. Small numbers of isolated, outlying Hafit tombs also suggest the existence of overland trade with other large Hafit communities on the other side of the Hajar Mountains. Interpretation of the socio-political nature of Hafit society is largely conjectural — the 'horizontal' distribution of the tombs makes it very difficult to suggest territorial boundaries, but territories may have centred on the Tertiary outcrops. The familiar elevated positioning of Hafit tombs and, in some cases, the careful choice of building material suggest that the nomadic population sought to proclaim their ownership of territory, especially when they were not present to do so in person.

In terms of the thesis as a whole, this chapter has provided the high-resolution Hafit tomb data for the Batinah that could not be gained through the NOP-GE survey described in the previous chapter. It has proved and explained the 'Batinah band' distribution of Hafit tombs first observed during this wider survey. It also provides valuable context for the Hafit cemetery case studies and settlement survey described in the next two chapters. Ideas and theories about Hafit society first expounded in this Batinah-wide research may be further tested and expanded upon in the following research.

More generally, this chapter has enormously augmented our understanding of Hafit archaeology and society in the Batinah region, and represents a significant effort in furthering the knowledge of the period in the northern Oman Peninsula as a whole. Prior to this research, only a small handful of Hafit sites were known from the Batinah — this chapter has mapped the location of over 6,000 suspected tombs from the period. Methodologically, this research applies the proof of concept of Hafit tomb remote sensing survey first trialled in Wadi 'Andam (Deadman 2012a,b) on a huge scale, covering the entire 12,500 sq-km area of the Batinah — by far the largest ever study area of a Hafit tomb survey (Figure 5.104). There is good evidence that is is possible to accurately distinguish Hafit tombs from LPTs, but the data and conclusions may need revisiting as more Batinah tomb data emerges, and the imperfect nature of the process demand that conclusions regarding Hafit society be tempered with due caution. The GIS analysis undertaken as part of this research provides a novel and scientific approach to the examination of tomb distribution in eastern Arabia. The results as a whole provide the basis for the one of the most in-depth discussions of Hafit society in the northern Oman Peninsula, and the first for the Batinah. Although beyond the focus of this thesis, the mapping of nearly 8,000 LPTs and the recording of a significant number of these structures are significant contributions to our generally poor understanding of burial traditions in the latter part of prehistory in the region.

Although this chapter has demonstrated the wealth of information that may be gained through large-scale Google Earth survey and GIS analysis of Hafit tombs, the critical importance of site and tomb-based fieldwork is not to be downplayed. A great deal about Hafit society may be best understood through thorough survey and study of individual cemeteries and tombs in the field — this will be the focus of the following chapter.

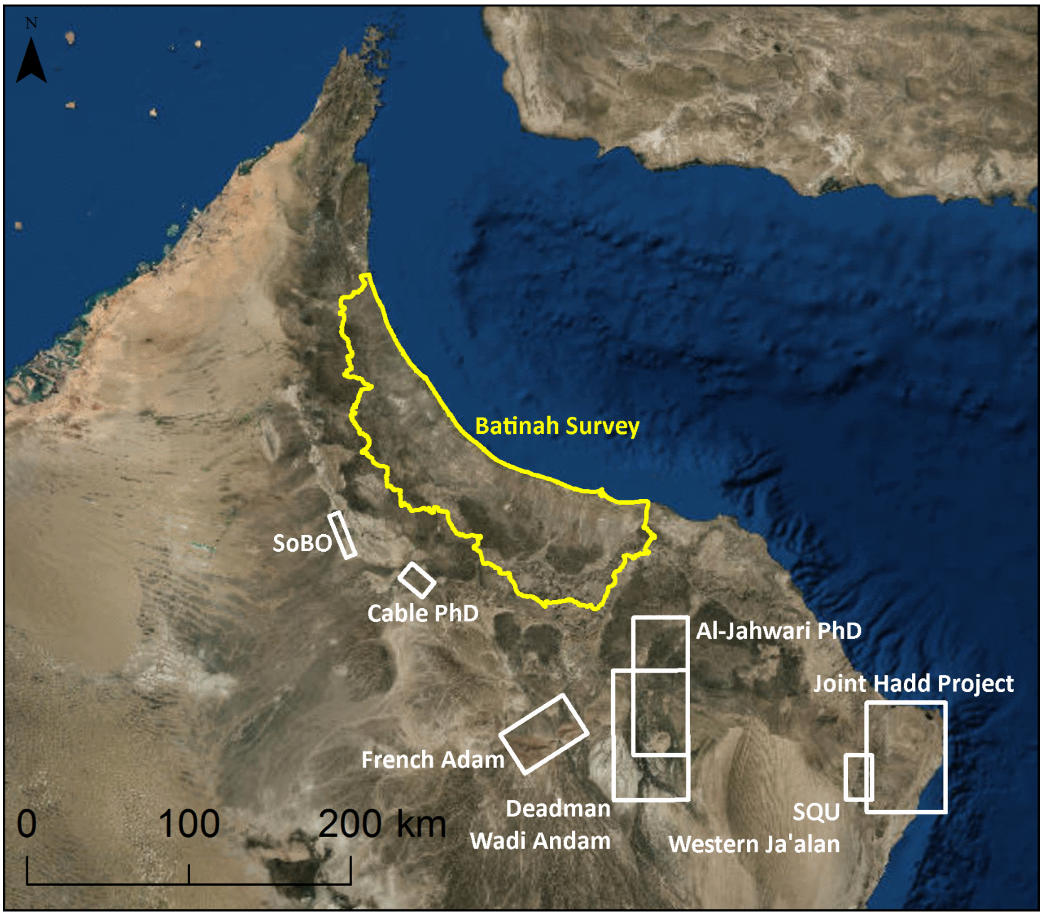


Figure 5.104: Comparison of the geographic extent of this research to other published Hafit tomb surveys

Chapter 6

Three Hafit cemetery case studies at Halban, Wadi al-Hoqain and al-Hamid

6.1 Introduction

Remote sensing and GIS analysis have proved useful in illuminating Hafit society in the Batinah (Chapter 5), and in the northern Oman Peninsula more widely (Chapter 4). However, these methods cannot and should not entirely replace archaeological fieldwork. Many of the gaps in our knowledge of the Hafit period can only be filled through survey and excavation. This chapter presents the findings of a detailed survey of three Hafit tomb sites in the Batinah: Halban; Wadi al-Hoqain; and al-Hamid (Figure 6.1). This ground-based research will add further detail to the picture of the Hafit economy and socio-political organisation that has emerged from the NOP-GE and B-GE surveys. The aim of this chapter is to examine the distribution and architecture of the tombs at these three sites as case studies of Batinah Hafit cemeteries.

Before the methods and findings of the survey may be described, firstly the geographical and archaeological background to the three Hafit tomb sites will be presented — including their topographical, hydrological and geological setting, and a full research history. The survey findings are analysed and discussed, interpreting what these three case studies may reveal about the nature of Hafit society in the Batinah.

Some early survey results were presented as a poster at the *Seminar for Arabian Studies* and were published in the subsequent proceedings (Deadman, Kennet, et al. 2015); the present author wrote the paper having also carried out the fieldwork, in some cases with the assistance of members of the RBAS team.

6.2 Background

Halban, Wadi al-Hoqain and al-Hamid are located in the southeastern half of the Batinah. The site of Halban lies on the outskirts of the village of the same name, within Barka *wilaya*, close to the border with the Muscat Governorate. The site of Wadi al-Hoqain is located on the eastern bank of the eponymous watercourse in the *wilaya* of Rustaq, it is approximately 5km north of the centre of the village of Hoqain, 2km north of the smaller settlement of Falaj as-Saidi. Al-Hamid is further west in the *wilaya* of al-Khaburah, approximately 2km south-southeast of the centre of the village itself, which is a modern settlement created for settled bedouin.

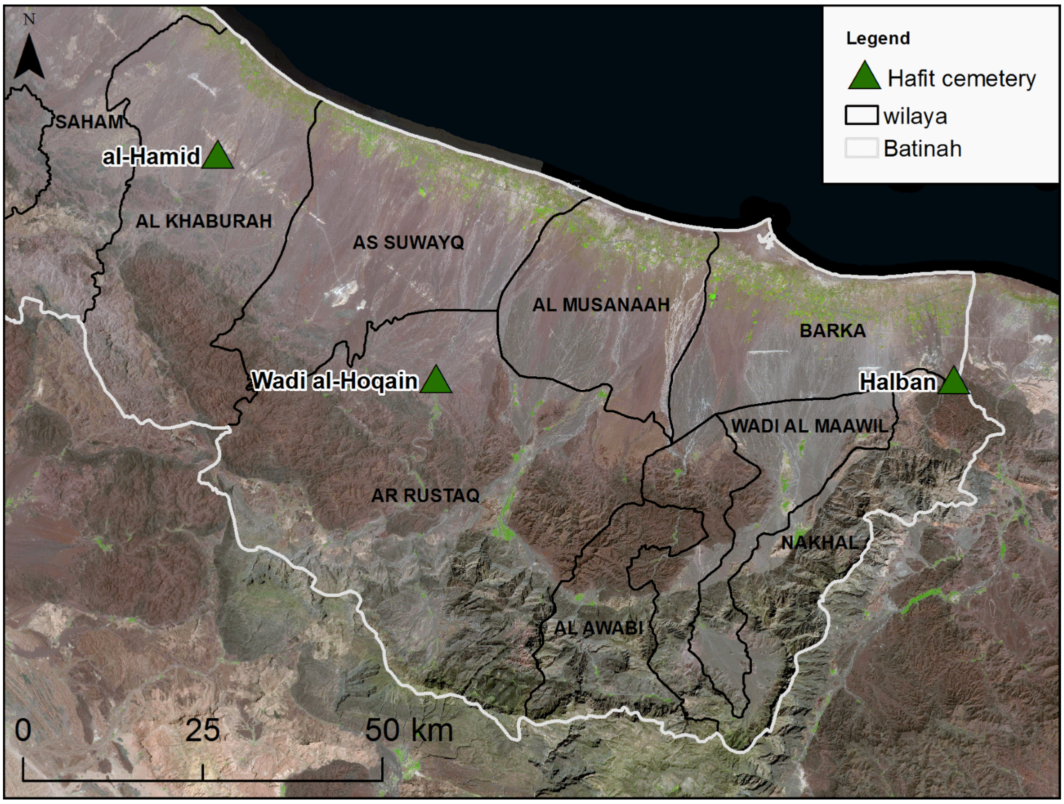


Figure 6.1: The location of the three sites — Halban, Wadi al-Hoqain and al-Hamid

The site of Halban lies at the eastern periphery of the village, stretched across a 500m-long area made up of discontinuous, low rocky terraces on the very edge of foothills at the end of the western range of the Hajar Mountains (Figure 6.2). To the north lies the gravel Batinah outwash plain that stretches approximately 14km to the sea. The agricultural village itself is one of a small number at the interface between the rocky foothills and the bajada zone; most of the arable farmland in the area is found to the north, part of the band of farms that runs along the Batinah coast. The village hugs the eastern bank of a minor tributary of Wadi Taww and is less than a kilometre from the main branch of the wadi. Wadi Taww is a sizeable watercourse that was dammed 2km downstream in 1992 — the reservoir holding a capacity of over 5 million cubic metres (Ministry of Agriculture and Fisheries 2012: Annex 1, table 6) — and drains an area of over 100 sq-km upstream of the site[1]. Geologically, the rocky terraces on which the site is situated consist of a thin Tertiary beach deposit overlying ophiolite (Figure 6.3). This terrace backs immediately onto a range of ophiolite hills that are known to contain considerable deposits of copper ore that have been mined in the past (Jan Scheurs, pers. comm. and Bouilly et al. 1993). The ophiolite that underlies the Tertiary terrace itself is visible in places and contains veins of green minerals that may contain copper, two confirmed major copper ore deposits are located less than two kilometres away to the southeast and southwest. The site also lies less than two kilometres from the line of the Tertiary ridge that runs across the Batinah — the suspected aquiclude that partially dams and lifts the flow of groundwater.

The Hafit tombs at Halban were first brought to the attention of archaeologists in 1993 by Ingeborg Guba, a geologist at Sultan Qaboos University (Yule 2001: 379; 1993: 148). The site was examined briefly by the German Archaeological Mission: the number of the tombs was recorded, the more obvious architectural characteristics of the structures were noted — especially the tomb facing — and the presence of Iron Age II pottery in and around the site was registered (Yule and Weisgerber 1998: 201–202). Photographs of the site were taken, a simple map was sketched, and a reconstruction of the largest Hafit tomb was drawn (Yule and Weisgerber 1998: figures 25–27). There are relatively few Hafit tombs in the local area surrounding the site. They have been reported near old al-Khod village some 7.5km to the east (Mershen 2002), and — according to the results of the B-GE survey (Chapter 5.3.2) — a sparse cemetery of Hafit tombs are situated on a large Tertiary outcrop approximately 3km to the west.

The site of Wadi al-Hoqain is situated on a narrow terrace between the wadi bed to the east and a tall range of hills on the west side; the tombs are spread across approximately 350m (Figure 6.4). The hills behind the site stretch for a further kilometre to the north and west, before the landscape gives way first to low hills of fluvial deposits, and then to 30km of gravel plain before reaching the coast. The site is located some distance from modern settlements: it is 2km downstream from Falaj as-Saidi on the opposite bank of the wadi; 5km downstream from Hoqain village itself; and more than 22km from the nearest agricultural settlement towards the coast. The site is only metres from the ~150m-wide bed of Wadi al-Hoqain (Figure 6.5), a significant watercourse that drains an area of more than 600 sq-km upstream of the site and, even in today's arid environment, frequently holds standing and running water in the winter months. Geologically, the site sits on a very narrow terrace — between 30 and 150m wide — of Quaternary fluvial material that is set several metres higher than the wadi bed. Behind the site lies a small range of

[1] this figure is based on a model created with the ArcGIS **Hydrological Toolset** (see Chapter 4.5.1)

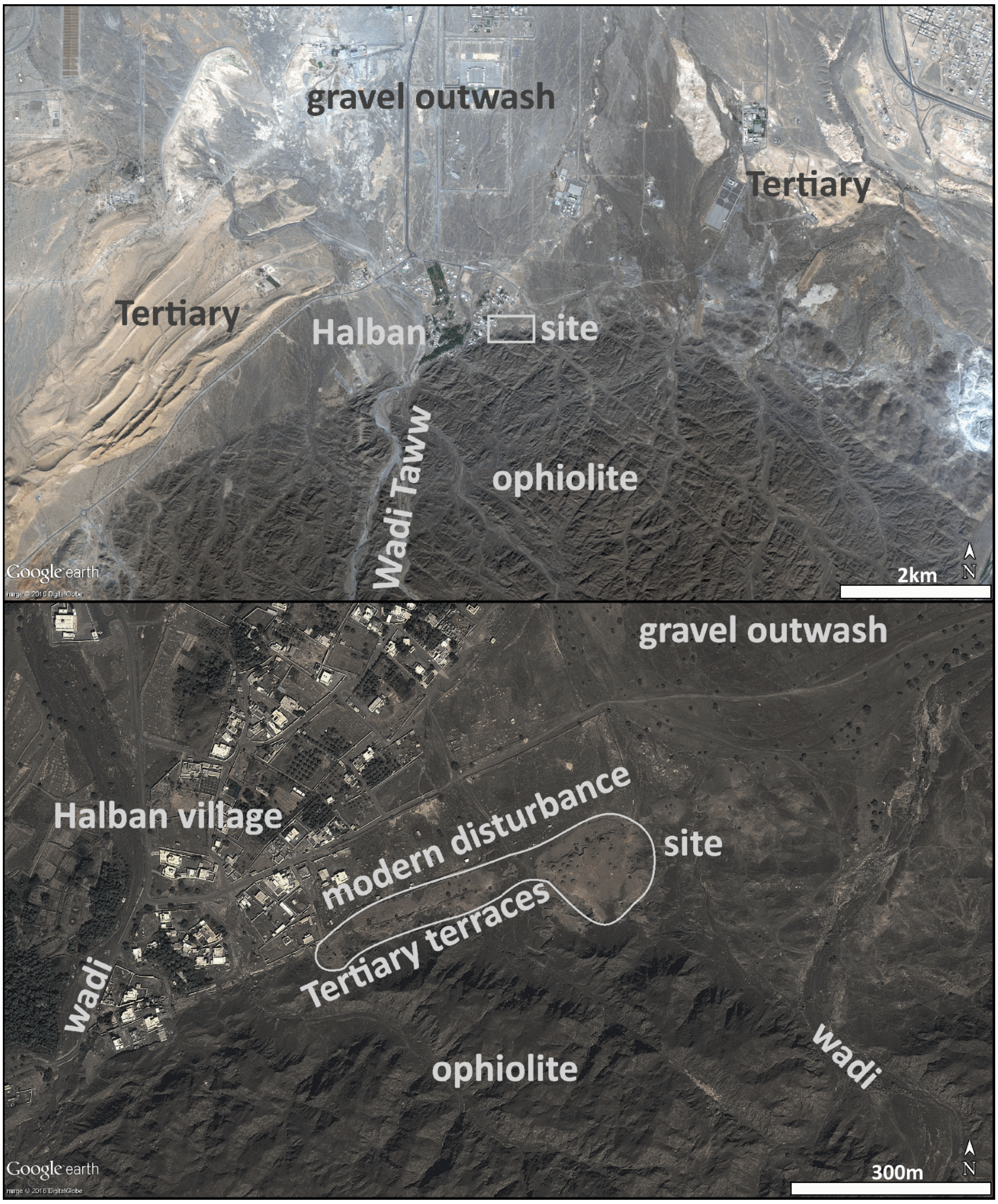


Figure 6.2: Annotated Google Earth imagery of context and site of Halban

ophiolite hills — ~3 sq-km in area — that jut out into the Quaternary fluvial deposits of the bajada outwash (Le Métour et al. 1993). Mineralogical maps show that these ophiliote hills, along with others in the area, are rich in copper ore deposits (Bouilly et al. 1993); archaeological evidence suggests that copper was smelted on a large scale at the nearby site of (Wadi) Miadin in the Bronze Age and Iron Age, ~5km from the site, generating thousands of tons of slag (Hauptmann 1985: 116–117; Goettler et al. 1976). The site lies at the interface between the rocky foothills and the bajada outwash, six kilometres from the line of the Tertiary aquiclude.

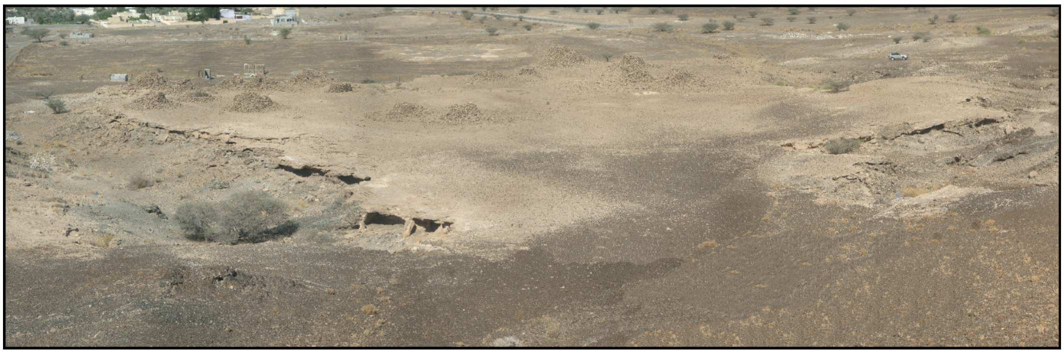


Figure 6.3: Oblique photomosaic of the easternmost terrace at Halban

Prior to this research, the archaeological site itself had not been reported. It was brought to the attention of the author, along with other members of the Rustaq-Batinah Archaeological Survey, by Khalifa al-Malmari, a farmer and archaeology enthusiast from Hoqain in 2013. The site is known as Tamr Abu Fudalah by local residents. According to the results of the B-GE survey, there are few other Hafit tombs in the immediate area, but large numbers are associated with the nearest part of the Tertiary aquiclude 5km to the northeast.

The site of al-Hamid is located on a small 'island' outcrop, part of a low central terrace that bifurcates a small wadi (Figures 6.6, 6.7). The hillock is 240m long and 100m at its widest, and is raised 3–5m above the surrounding area; the cluster of Hafit tombs are restricted to the knoll's fatter, southern half. The site is located 1.5km south-southwest of al-Hamid itself — a recently settled bedouin village which does not appear on older maps (e.g. Le Métour et al. 1993); more established villages are found more than 5km away to the northwest and southeast, hugging the two nearest major wadis, or 8km away to the band of coastal Batinah farms to the northeast. The coast itself is more than 14km away. A few hundred metres from the site, the bifurcated wadi channels join a more substantial watercourse that drains an area of approximately 40 sq-km — the equivalent of a small stream in a less arid climate. Geologically, the outcrop is made up of a part of a Hawasina formation that also forms the more substantial neighbouring hills to the south and west. The site is extremely close to the largest outcrop of the Batinah Tertiary ridge, only a few hundred metres to the northeast; the pale buff rock towers over the surrounding area, and is several hundred metres wide. The small stream bed runs through an eroded opening in the ridge towards the coast. The hills surrounding the site are primarily made up of Quaternary fluvial material of the bajada zone, but also some Hawasina outcrops. Ophiolite fields are situated only three kilometres to the southwest of the site; they contain large deposits of copper ore, as well as a major stockworks, which are sufficiently substantial for large-scale modern exploitation to be economically viable (Bouilly et al. 1993; Le Métour et al. 1993).

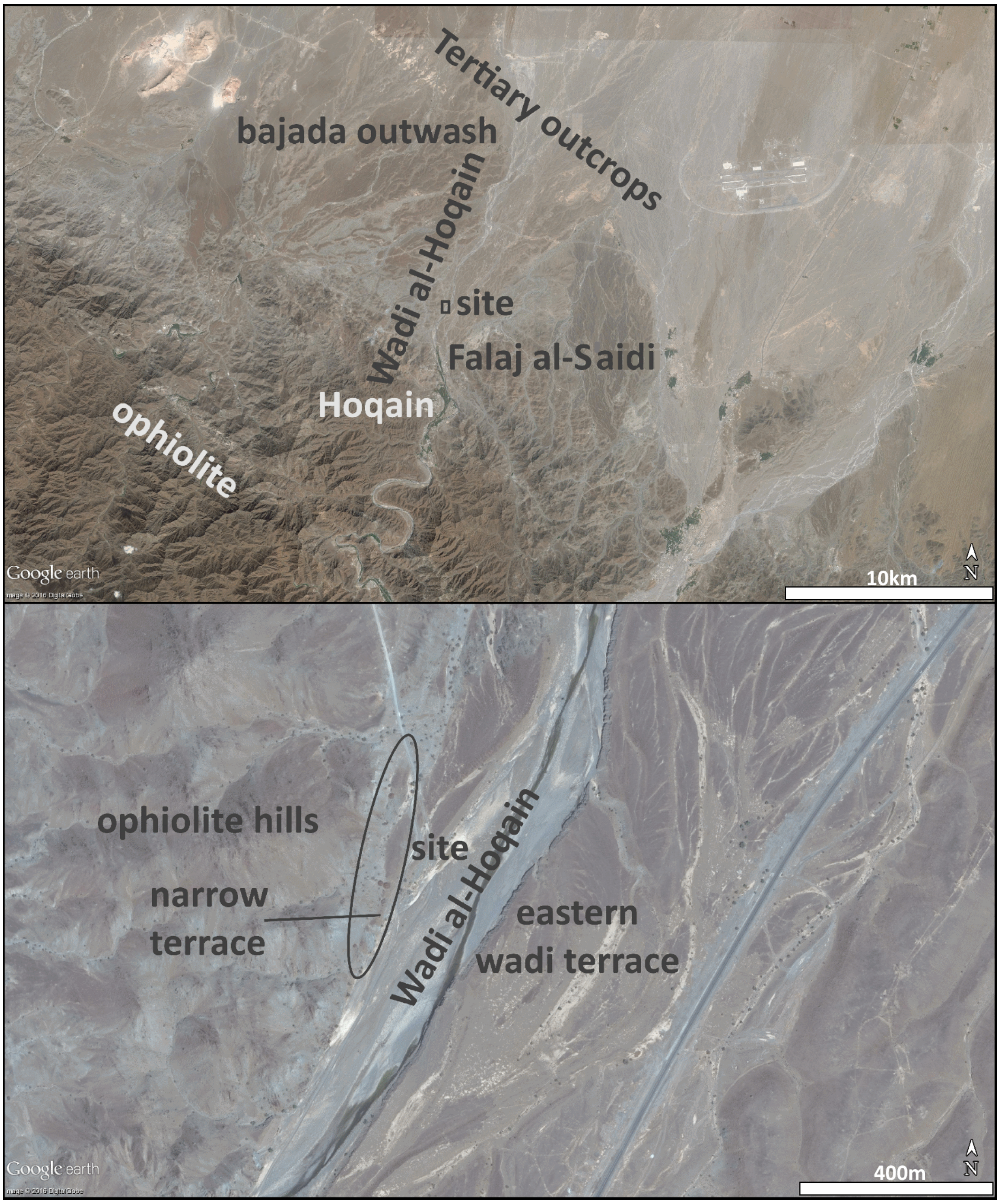


Figure 6.4: Annotated Google Earth imagery of context and site of Wadi al-Hoqain

The Hafit tombs at al-Hamid were recently brought to the attention of archaeologists by Khamis al-Aufi, an official from the Sohar branch of the Ministry of Heritage and Culture, who showed them to the author while undertaking a survey of the nearby planned route of the Batinah Express Highway as part of the Rustaq-Batinah Archaeological Survey project in 2013 (Kennet, al-Jahwari, Deadman, and Mortimer 2014). According to the results of the B-GE survey, the site's Hafit tombs are part of a much larger group of over a hundred similar funerary structures in the surrounding area that are associated with the Tertiary aquiclude; the closest of these neighbouring Hafit tombs are less than 400m away (Chapter 5.3.2).

Figure 6.5: Oblique photo of the central part of Wadi al-Hoqain

Figure 6.6: Mosaicked kite photo of al-Hamid (courtesy of Mark Woolston-Houshold, RBAS)

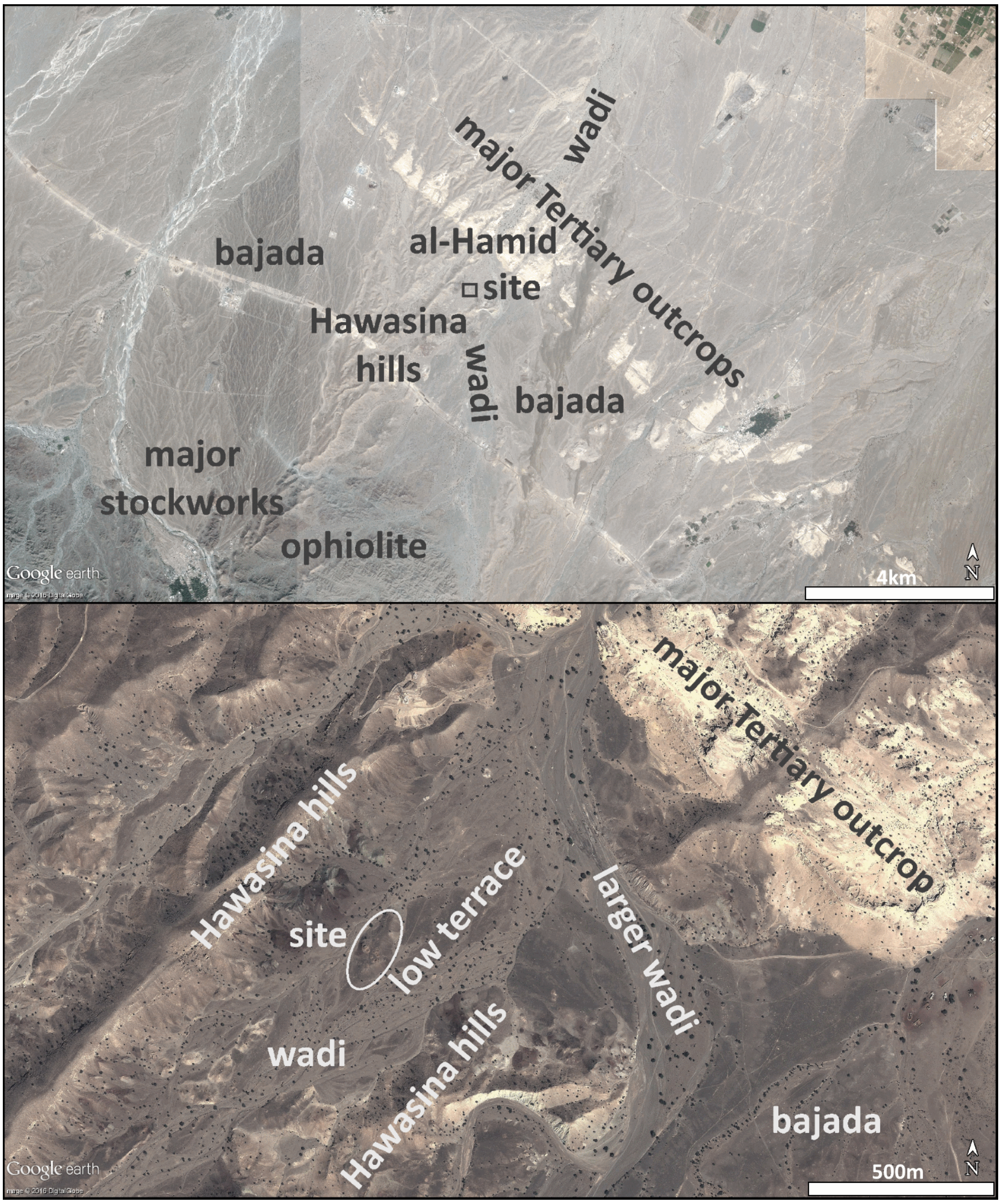


Figure 6.7: Annotated Google Earth imagery of context and site of al-Hamid

6.3 Method

Field survey was carried out at each of the three sites — each Hafit tomb was recorded, as well as any LPTs. Standardised record sheets were used in the recording process (Table 6.1, Figure 6.8); photographs and GPS coordinates were taken for each tomb.

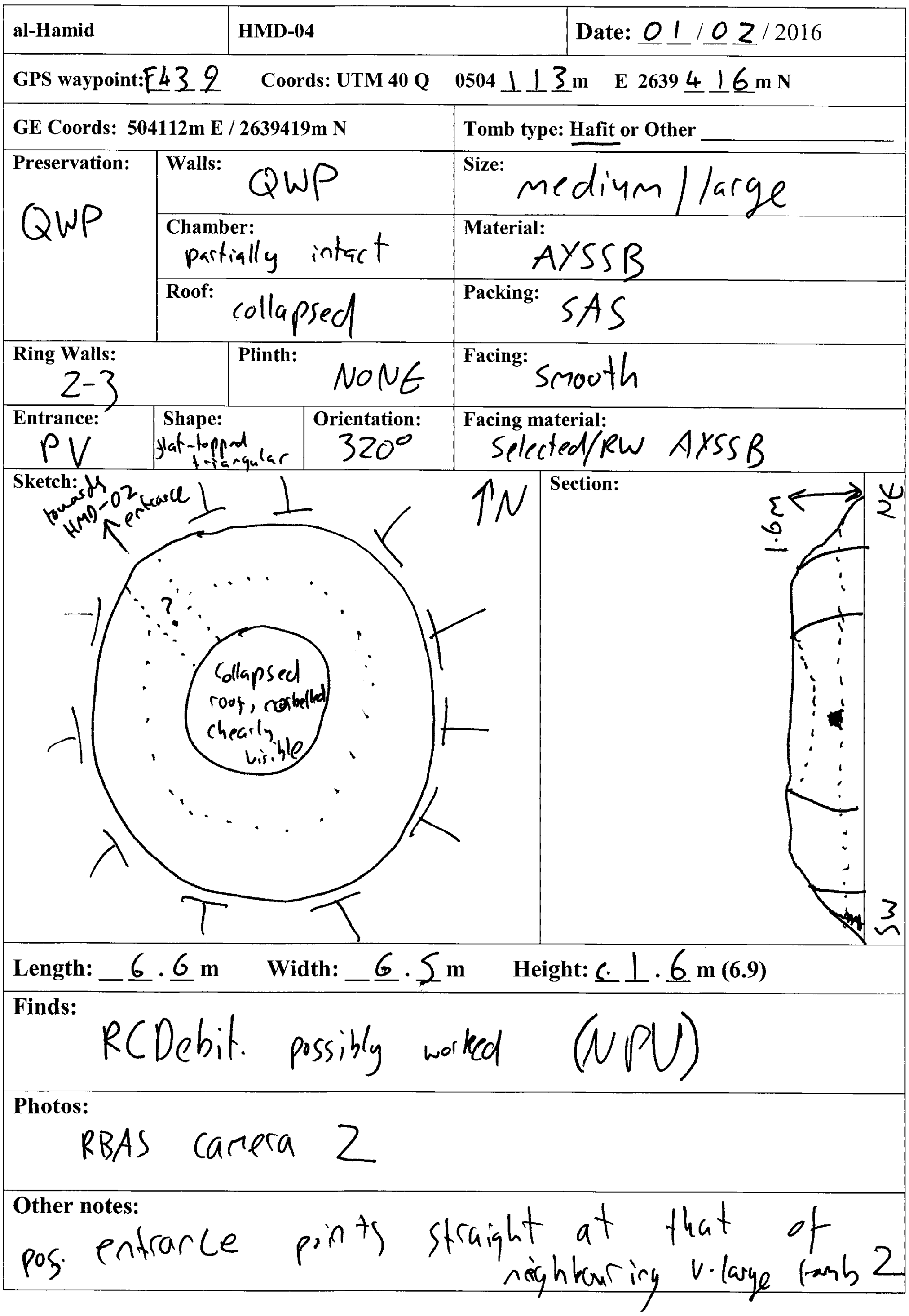
Table 6.1: Tomb characteristics recorded during fieldwork

ID:	site name tomb ID number	date
Location:	GPS waypoint number	GPS UTM coordinates
Architecture:	tomb type tomb size tomb preservation wall preservation chamber preservation roof preservation building material packing material	facing facing material number of ring walls plinth (presence/absence) entrance (presence/absence) entrance shape entrance orientation
Sketches:	plan sketch	section sketch
Dimensions:	length width	height
Other:	surface finds observed photo notes	other notes

In addition, pole photography — and at al-Hamid, kite aerial photography — was also undertaken to provide general oblique site shots, and birds-eye images of a number of typical tombs. The former was carried out with an extendible pole, with a WiFi-enabled camera controlled from an Android tablet; in some cases images were mosaicked to create partial panoramas of the sites with Microsoft Image Composite Editor. The kite aerial photography was kindly undertaken by Mark Woolston-Houshold during the Rustaq-Batinah Archaeological Survey field season — his methodology is described in the preliminary project report (Kennet, al-Jahwari, Deadman, and Mortimer 2014: 76–78).

Hand-held units were used to take GPS coordinates for each tomb. As the inaccuracy of these units is up to 15m (at 95% probability, Garmin 2005), the coordinates were corrected using Google Earth imagery.

Tomb dimensions were measured with a tape measure; in the small number of cases where a tomb was too tall for this to be possible, numerous tape measures, a compass and ranging poles were used to measure an estimated diameter and — for al-Hamid — this measurement was verified with the kite aerial photography. Maximum tomb height was



al-Hamid	HMD-04	Date: 01 / 02 / 2016

GPS waypoint: F439 Coords: UTM 40 Q 0504 113 m E 2639 416 m N

GE Coords: 504112m E / 2639419m N | Tomb type: Hafit or Other

Preservation:	Walls: QWP	Size: medium / large
QWP	Chamber: partially intact	Material: AYSSB
	Roof: collapsed	Packing: SAS

Ring Walls: 2-3	Plinth: NONE	Facing: smooth

Entrance: PV	Shape: flat-topped triangular	Orientation: 320°	Facing material: Selected/RW AYSSB

Sketch:

Section:

Length: 6.6 m Width: 6.5 m Height: c. 1.6 m (6.9)

Finds: RCDebit. possibly worked (NPU)

Photos: RBAS camera 2

Other notes: pos. entrance points straight at that of neighbouring v. large tomb 2

Figure 6.8: Example of filled Hafit tomb record sheet from al-Hamid

estimated to the nearest 10cm using ranging poles. Entrance orientation was measured with a mirror compass, carefully sighting through the entrances towards the back walls of the tombs.

The presence of surface finds at the sites — and around specific tombs — was noted, but no pick-ups were undertaken. Non-funerary archaeology at, or near to, the sites was noted but not recorded in detail.

6.4 Results

In total 55 tombs were recorded at the three Hafit cemeteries; the results from each site will be presented separately.

6.4.1 Halban

The cemetery of Halban consists of thirty-five tombs of four types spread across four Tertiary terraces that stretch over half a kilometre. The majority of these tombs — 26 of the 35 — are Hafit; there are also six Cell Graves, two early Umm an-Nar tombs and one probable Islamic grave. Most of the tombs are located on the largest, eastern terrace (Figure 6.9) — 20 in total, 16 Hafit tombs, three Cell Graves and an Umm an-Nar tomb — while the probable Islamic grave is situated on the plain immediately below and to the north. The other tombs are spread across the three smaller terraces in the western part of the site. The terraces are punctuated by eroded areas formed by water flowing from the hills to the south immediately behind the site, which may have been enlarged by the quarrying of Tertiary rock or by the mining of copper-containing minerals in the underlying ophiolite.

The Hafit tombs are clustered — with a distance of only a few metres to the nearest structure — in groups of varying sizes: two lone tombs are more than fifty metres from others on their own small terrace; five others are set apart at a slight distance of just over 10m from a nearby cluster; otherwise they are clustered in groups of two (x2), five, and nine tombs. Three of the Cell Graves are located on the main terrace, with a regular distance of 30–40m between them and set slightly away from the Hafit tombs, two others are located among the large eastern cluster of Hafit tombs on the third terrace, and the last is set slightly apart from the central lone Hafit structure. The early Umm an-Nar tombs are located at either end of the site, each near to the two largest clusters of Hafit tombs but set in front of them, in one case slightly below their level. The possible Islamic grave is 30m north of the nearest Hafit tomb, part of the largest cluster on the main terrace. No other archaeological structures were found at the site, although the plain immediately below the tombs has been extensively disturbed by modern agriculture and building. A variety of pottery was observed across the site, with particular density in the central gully

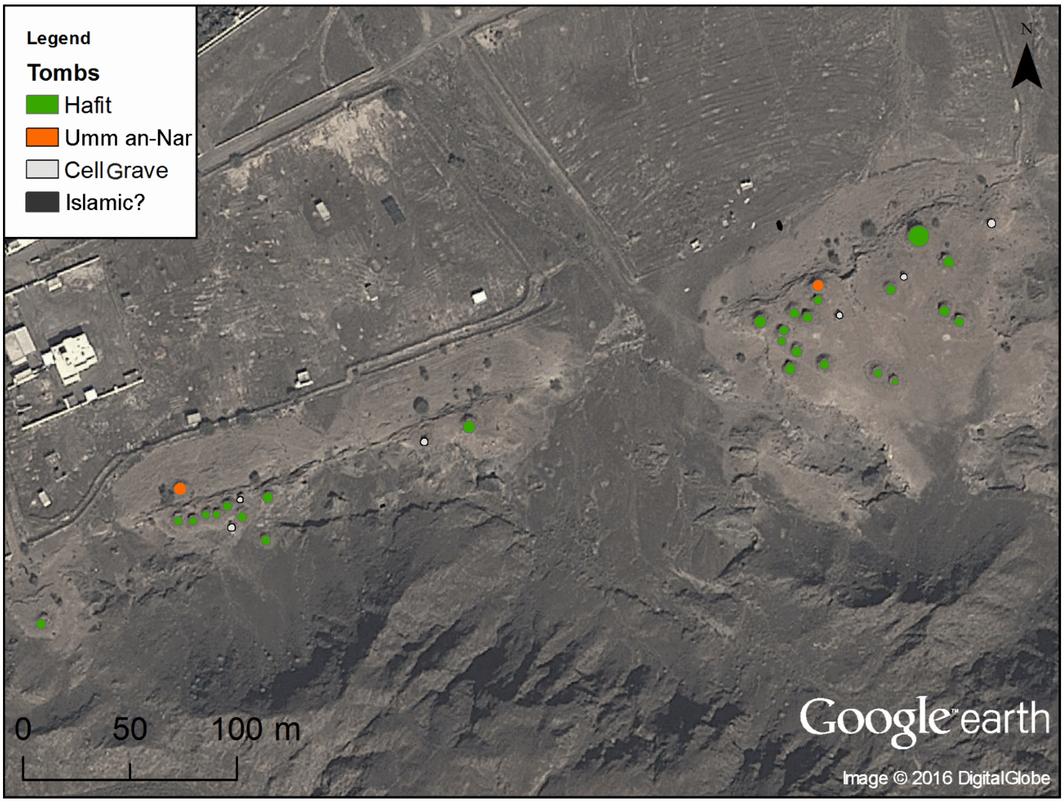


Figure 6.9: Map of type and approximate diameter of tombs recorded at Halban

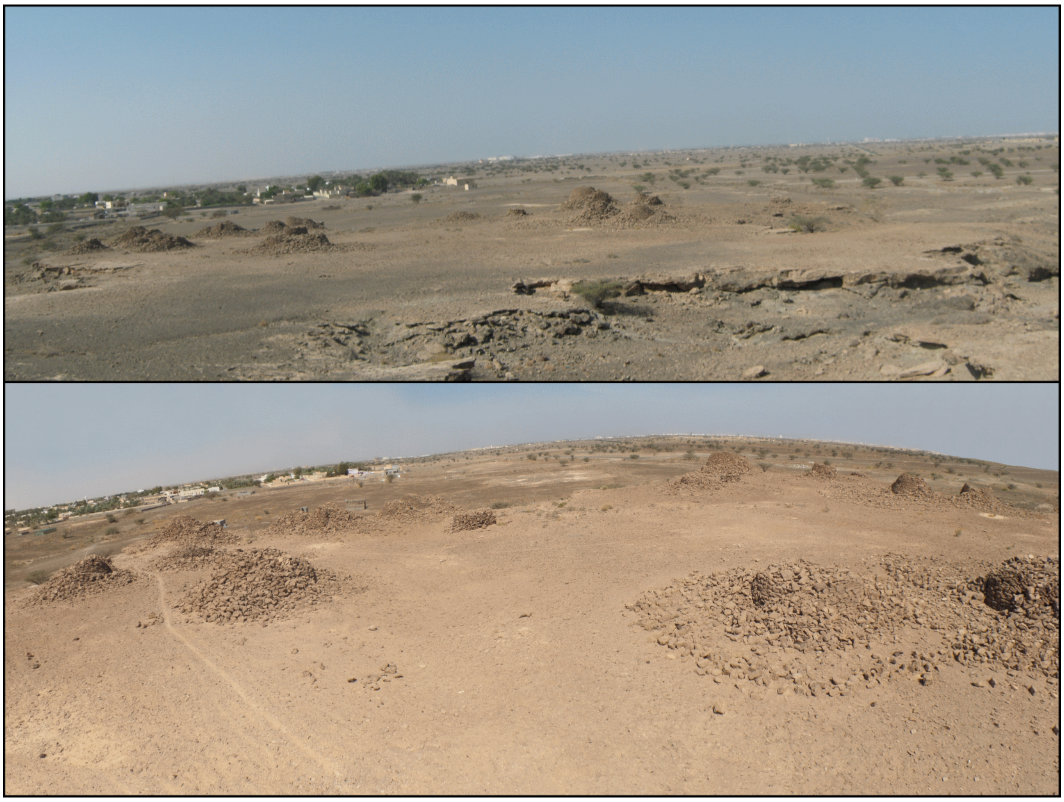


Figure 6.10: mosaicked ground and pole photos of largest cluster of tombs at Halban

separating the large terrace from the rest of the site. The sherds date from the Iron II period — coarse storage jars and some possible fine wares — through to the Late Islamic period — red and cream wares.

The tombs at Halban are remarkably well preserved (Table 6.2). Out of 26 Hafit tombs, 20 are 'very well preserved' with walls that are mostly standing, or with a roof that is mostly or partially intact; three Hafit tombs are 'well preserved' with walls still standing in places; and three are 'quite well preserved' with walls that are probably partially standing under rubble (Figure 6.11). Four of the Cell Graves are 'very well preserved' and two are 'quite well preserved', one of the Umm an-Nar tombs is 'very well preserved' and the other is 'well preserved'. The possible Islamic grave is in a disturbed condition.

Table 6.2: Preservation of tombs at Halban

	Hafit Tombs	Cell Graves	Umm an-Nar	Other
very well preserved	20	4	1	
well preserved	3		1	
quite well preserved	3	2		
disturbed				1
badly disturbed				
TOTAL	26	6	2	1

Figure 6.11: Examples of condition of Hafit tombs at Halban

The Hafit tombs at Halban are constructed from blocks and slabs of Tertiary rock. This material forms a thin layer overlying the ophiolite bedrock of the terrace and would naturally form suitable pieces when quarried or undermined through the erosion of the softer stone beneath (Figure 6.12). The masonry used in the Hafit tomb walls is mostly unworked, is all roughly of a similar size — between a brick and a breeze block — and varies in thickness from quite thin slabs to substantial blocks. In some of the tombs on the western side of the site, sometimes the occasional broken, angular wadi cobble is included.

Figure 6.12: Overlying Tertiary material at Halban from which the tombs are built, and typical unworked masonry

Most of the Hafit tombs have two concentric ring-walls, but a small minority of the larger examples appears to have three, and the very largest may even have four. The space between the walls is packed with smaller, more angular, less regular stones of the same rock. The Hafit tombs' outer walls are smooth: in most cases the unworked, or very roughly worked, stones have been carefully selected and fitted; in others small gaps in the wall facing have been plugged with smaller stones, either of the same material or with white stone (Figure 6.13, Table 6.3).

Figure 6.13: Hafit tomb facing at Halban: selected stones; and carefully selected stones with plugging

Table 6.3: Occurence of facing types and small plugging stones in Hafit tombs at Halban

	unworked/roughly worked	some working	TOTAL
no plugging	18		18
Tertiary rock plugging	3	1	6
white rock plugging	3	1	4
TOTAL	24	2	26

The entrances of two Hafit tombs are clearly visible and are possibly visible in three others (Table 6.4, Figure 6.14). Both of the clearest examples are rectangular, with a large slab serving as a lintel. Two of the possible entrances are similar, but a third is triangular in shape, with masonry corbelled to form a hole in the side of the tomb. The five entrances are oriented between 102°and 120°— from east by south to southeast by east.

Table 6.4: Entrances in Hafit tombs at Halban

	Entrance	Shape	Orientation (°)
HLB-09	clearly visible	rectangular	110
HLB-22	clearly visible	rectangular	102
HLB-02	possibly visible	triangular	111
HLB-13	possibly visible	rectangular	108
HLB-17	possibly visible	rectangular	120

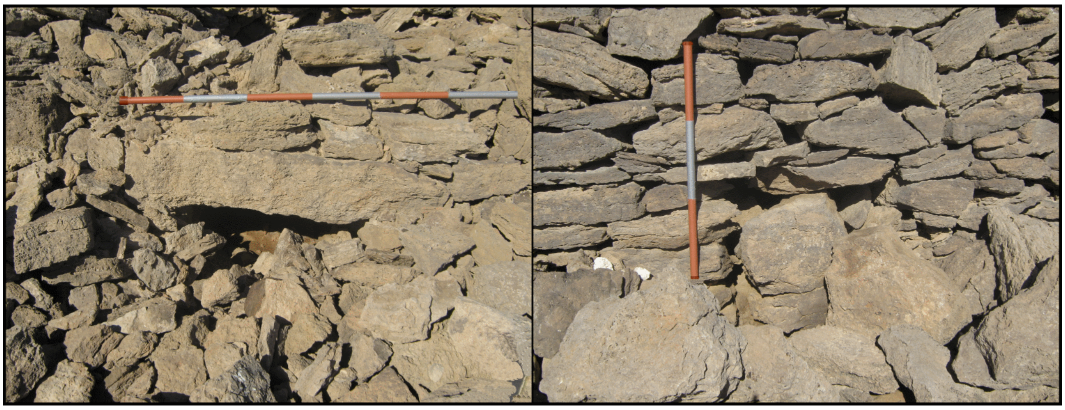


Figure 6.14: Examples of clearly visible and possibly visible (and blocked) Hafit tomb entrances at Halban

All of the Hafit tombs at Halban are circular or sub-circular — the maximum difference between the length and width is 40cm — but, there is considerable variation in the diameter of the structures (Figure 6.15, Table 6.5). The majority of Hafit tombs have a diameter of between 4 and 5.5 metres (22 of 26), the smallest being 3.2m. The largest tomb is a significant outlier with a diameter of 9.8m, more than half-again that of the next largest structure (Figure 6.16).

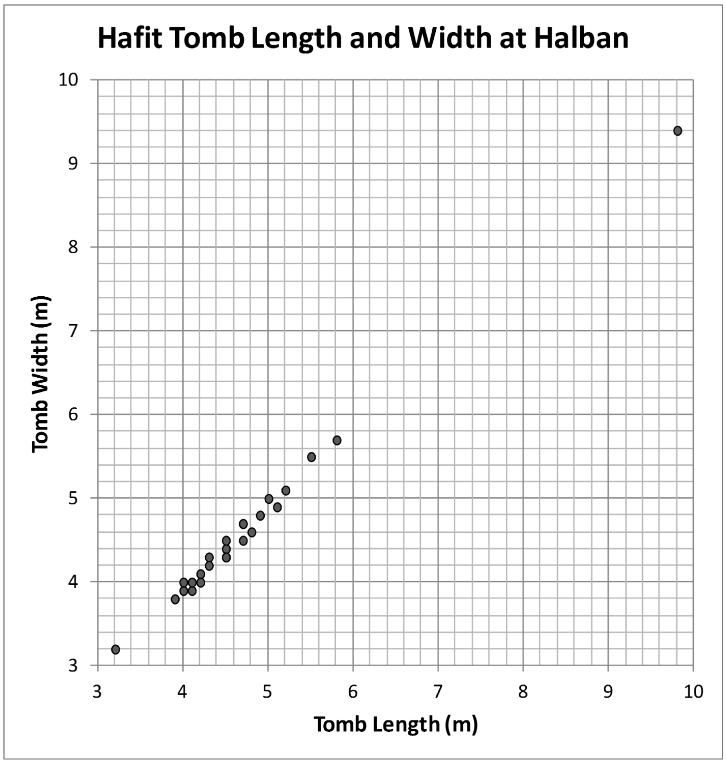


Figure 6.15: Graph of length and width of Hafit tombs at Halban

Table 6.5: Descriptive statistics for Hafit tomb length and width at Halban

	Length (m)	Width (m)
minimum	3.2	3.2
maximum	9.8	9.4
median	4.5	4.35
mode	4.5	4.3
mean	4.7	4.61
stan. dev.	1.2	1.1

Figure 6.16: Approximately scaled photographs showing the range in size in Hafit tombs of similar condition at Halban

The height to which the Hafit tombs survive at Halban ranges from 1 to 3.5m (Table 6.6). The tombs that are in the best condition have roofs that are partly surviving, suggesting that originally they would have been only slightly taller than their current height of ~2m. However, the one very large Hafit tomb — unique at the site — is over 3.5m tall (Figure 6.17).

Table 6.6: *Descriptive statistics for height of very well preserved Hafit tombs and all Hafit tombs at Halban*

	VWP tombs	all tombs
minimum	1.4	1.2
maximum	3.5	3.5
median	1.9	1.8
mode	2.2	2.2
mean	1.9	1.8
stan. dev.	0.5	0.5

Figure 6.17: HLB-02 — the largest Hafit tomb at Halban

The architecture of the two Umm an-Nar graves at Halban is generally very similar to many of the Hafit tombs. The are perfectly circular in plan with diameters of 5.5 and 5.1m; the 'very well preserved' tomb stands 2.4m high and the larger 'well preserved' tomb 1m high. They are built of the same Tertiary rock with a similar construction. The major difference with Hafit tombs is the facing of outer walls, which consists of carefully carved Tertiary blocks with a slightly convex face and inwardly sloping sides — diagnostically Umm an-Nar 'sugarlump' stones (Figure 6.18).

Figure 6.18: Two early Umm an-Nar tombs at Halban

The six Cell Graves at Halban are very different to the Hafit tombs (Figure 6.19). The structures are built of rough blocks of Tertiary rock; the dimensions of the blocks vary quite considerably, but in general the larger pieces are found in the lower courses. Two walls are present in each tomb, with the intervening space filled with a packing of gravel and small rocks. No effort was made to face the tombs — the outer walls are rough and jagged, and angled inwards only slightly. Despite excellent preservation, no entrances in the side of the tombs were observed. The tombs are oval in shape, with a central oval chamber. In no cases do roofs remain in situ, most have collapsed into the tombs' chambers, but loose slabs were found around some tombs that may have been used to bridge the corbelled gap over the chambers. The tombs are between 3 and 3.7m long and 1 and 1.4m tall (Table 6.7) — which, based on the condition of the structures, is very close to their original height.

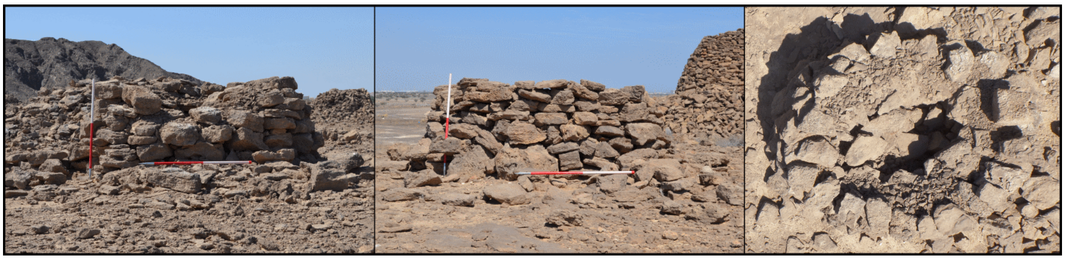


Figure 6.19: A typical Cell Grave at Halban

Table 6.7: Dimensions of Cell Graves at Halban

Tomb	Length (m)	Width (m)	Height (m)
HLB-01	3.7	3.0	1.1
HLB-30	3.6	3.1	1.2
HLB-34	3.6	3.0	1.0
HLB-11	3.1	2.5	1.4
HLB-06	3.0	2.5	1.1
HLB-29	3.0	2.4	1.1

The one unique tomb at Halban is a semi-subterranean grave located on the plain immediately below the main terrace. It consists of a long, low mound of earth and gravel, with Tertiary slabs placed edgewise into it, creating a stone alignment along its length (Figure 6.20). The orientation of the possible grave — approximately north-south — matches *qibla*, and so although the grave architecture is not entirely consistent with Islamic burial in Oman, it probably dates to some point in the Islamic period. It is ~4m long and 1.5m at the widest.

Figure 6.20: The possible Islamic grave at Halban

6.4.2 Wadi al-Hoqain

The site of Wadi al-Hoqain consists of seven tombs of at least two types, as well as a number of areas of insubstantial wadi cobble structures, stretched across a 400m wadi terrace (Figure 6.21). Four of the tombs are clearly Hafit structures, one is a LPT and the remaining two, which have been severely robbed of stone, are probably small Hafit tombs. The tombs are clustered in three groups across the terrace; in-between these and to the north and south are areas of less substantial, and probably non-funerary, wadi cobbles features (Figure 6.22). The terrace is narrow; below and to the east of the site lies the bed and channel of Wadi al-Hoqain, while to the west — backing immediately onto the terrace — lies a range of ophiolite hills.

The southernmost funerary structure is a Hafit tomb; the only clear LPT lies ~15m to the north-east. The main cluster of tombs is 120m NNE (Figure 6.23) — two 'well preserved' Hafit tombs, and two probable Hafit structures that have been almost completely robbed of stone; each tomb is within 15m of another. Finally, ~170m to the north lies the last Hafit tomb, standing alone, but with insubstantial wadi cobble structures stretching to the north and south. No surface finds were observed anywhere on the wadi terrace, including the areas around the tombs and the wadi cobble settlement structures.

The preservation of the tombs at Wadi al-Hoqain varies considerably (Table 6.8, Figure 6.24). Three of the Hafit tombs are 'very well preserved' — with walls mostly standing and roofs partially intact; a fourth is 'well preserved' with walls standing to a considerable height in places. Two other probable Hafit tombs are 'badly disturbed' — they appear to have been robbed of stone down to the second-lowest visible course. The LPT is in 'disturbed' condition — the walls survive to a considerable height, but the roof has completely collapsed, and the rubble has filled the chamber, completely obscuring the internal layout.

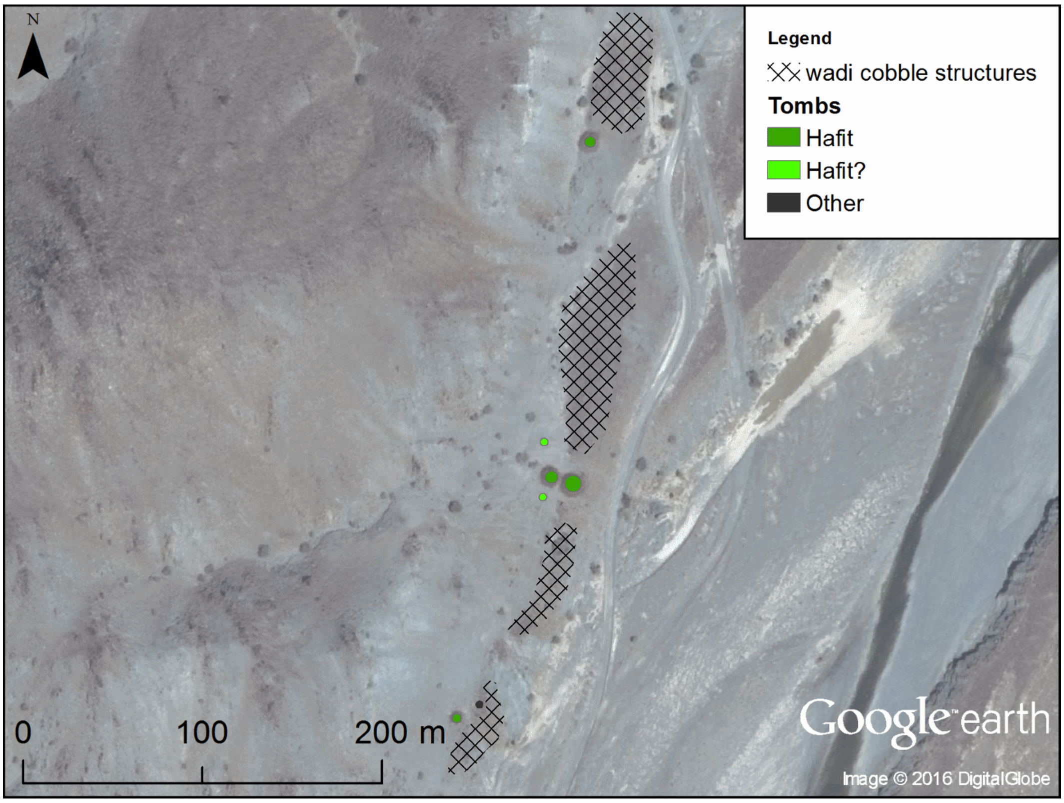


Figure 6.21: Map of type and approximate diameter of tombs recorded at Wadi al-Hoqain

Figure 6.22: Examples of wadi cobble structures present at Wadi al-Hoqain

Table 6.8: Preservation of tombs at Wadi al-Hoqain

	Hafit Tombs	Hafit Tombs?	LPT
very well preserved	3		
well preserved	1		
quite well preserved			
disturbed			1
badly disturbed		2	
TOTAL	4	2	1

The Hafit tombs at Wadi al-Hoqain are constructed from a combination of angular pieces of the ophiolite bedrock and darkly patinated wadi cobbles — readily available from the nearby hills and wadi bed. Generally, the masonry is not worked, but consistently

Figure 6.23: The central cluster of Hafit tombs at Wadi al-Hoqain

Figure 6.24: Examples of condition of Hafit tombs at Wadi al-Hoqain: 'badly disturbed'; and 'very well preserved'

sized pieces are used throughout the structures. Each Hafit tomb is made up of at least two concentric ringwalls; the largest structure may have up to five. The space in-between the walls is packed with angular stones that are considerably smaller and more irregular than those used for the walls. The facing of the outer walls is quite smooth — achieved through the careful selection and placement of masonry, the minority of which may have been roughly worked. In two of the Hafit tombs, gaps in the wall facing were plugged with small, angular stones. In the largest of these two tombs, the plugging stones are very common and facing stones were very carefully selected and placed — wadi cobbles with a shallow and regular convex shape, giving a particularly smooth finish to the wall face (Figure 6.25). Side entrances are clearly visible in three of the Hafit tombs (Table 6.9, Figure 6.25); they are rectangular in shape and are orientated between southeast and west.

Figure 6.25: The two major wall facing styles (left and centre), and two clear entrance examples in Hafit tombs at Wadi al-Hoqain (centre and right)

Table 6.9: Entrances in Hafit tombs at Wadi al-Hoqain

	Entrance	Shape	Orientation (°)
HQN-01	clearly visible	rectangular	204
HQN-03	clearly visible	rectangular	140
HQN-07	clearly visible	rectangular	260

The Hafit tombs are circular or sub-circular in shape — the aspect ratio of the most oblate being approximately 20:19. Despite the regularity of their shape, there is considerably variation in the size of the tombs (Table 6.10). The smallest of the tombs are the two badly disturbed structures — both are just under 4m in diameter; the largest is more than twice this size. The height to which the Hafit tombs survive depends on their condition and their size: the largest 'very well preserved' tomb stands nearly 3m tall and the smaller examples stand between 1.5 and 2m high; while the small, robbed tombs protrude only 60 and 30cm above the surface.

Table 6.10: Dimensions of Hafit tombs at Wadi al-Hoqain

Condition	Tomb	Length (m)	Width (m)	Height (m)
very well preserved	HQN-01	6.1	5.9	1.9
	HQN-04	9.5	8.9	2.8
	HQN-07	5.1	4.9	1.6
well preserved	HQN-03	7.1	6.9	1.8
badly disturbed	HQN-02	3.9	3.8	0.3
	HQN-05	3.9	3.8	0.6

The lone LPT is also constructed from a combination of wadi cobbles and angular pieces of bedrock, but the cobbles make up the majority — the opposite of the Hafit tombs. Although the structure of the tomb is obscured, it appears to consist of two ringwalls, with the space in-between packed with small wadi cobbles (Figure 6.26). No effort was made to face the outer wall which is irregular and largely constructed from round wadi cobbles. There is no side entrance in the walls of the tomb. The structure is almost circular in shape

— 3.8 by 3.7m — and survives to a height of 90cm. It is not unlikely that it is the remains of a Cell Grave, but the condition of the structure makes it difficult to be sure and it may be of a different type.

Figure 6.26: The round LPT at Wadi al-Hoqain

6.4.3 Al-Hamid

The cemetery site of al-Hamid consists of thirteen tombs stretched across a low, small hillock (240x100m) that lies between two minor wadi channels (Figure 6.27). All of the tombs are clearly Hafit, and are restricted to the southern half of the knoll. Most of the tombs are within 3–5m of their nearest neighbour, and all of the structures are within 15m of another (Figure 6.28) apart from HMD-01 which is set apart some 20m north of the main cluster. This may well be significant as HMD-01 is the smallest tomb, and is clearly in the poorest condition. Possible anthropogenic debitage of red and green chert was found amongst the tombs; no pottery was observed. As well as the Hafit tombs on the hillock, on the lower terrace to the northeast — below the knoll but still set above the two wadi channels — there is a large area of insubstantial and deflated stone features (Figure 6.29); more possible red and green chert debitage was found in and around this area, but this material could easily date to an earlier period. The terrace is approximately 300x200m in size.

In general, the preservation of the Hafit tombs at al-Hamid is very good (Table 6.11). Two of the tombs are 'very well preserved', with walls that are mostly standing and a roof that is partially intact; one tomb is 'well preserved', with walls that are still standing in places; eight tombs are 'quite well preserved', with walls that are still standing to some extent but are mostly buried under rubble; one tomb is 'disturbed', with walls that have almost completely collapsed; and one tomb is 'badly disturbed', with walls that have been robbed of stone down to the lowest course in places (Figure 6.30).

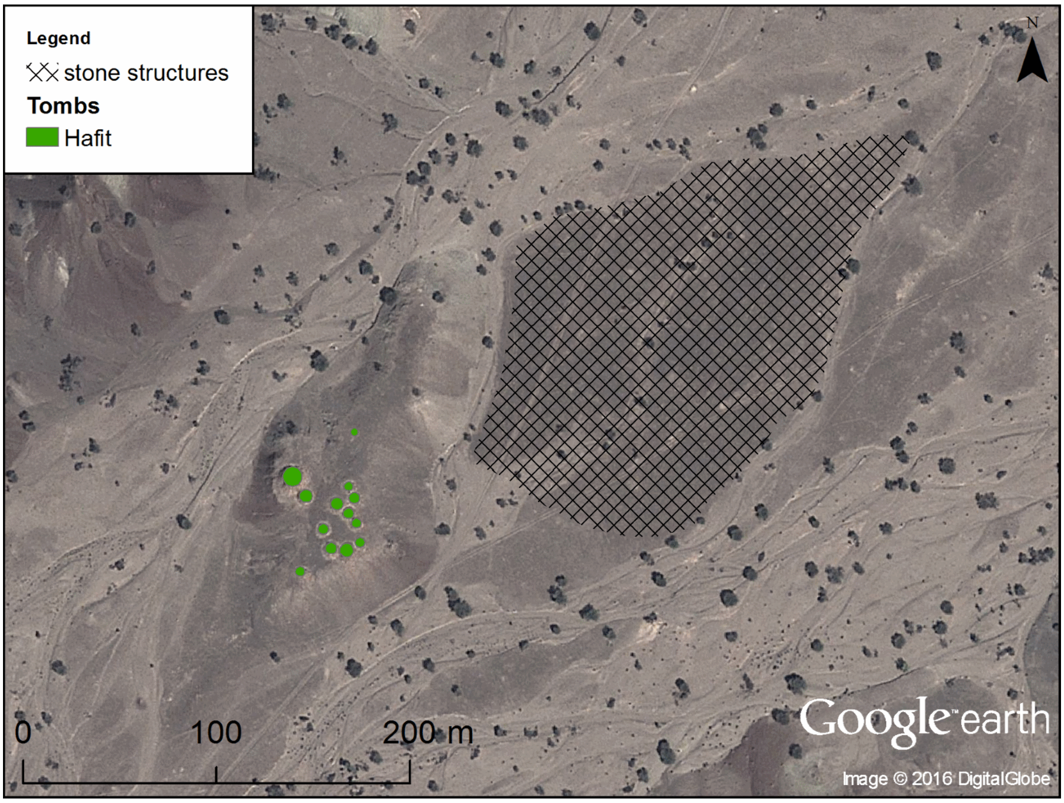


Figure 6.27: Map of approximate diameter of Hafit tombs recorded at al-Hamid

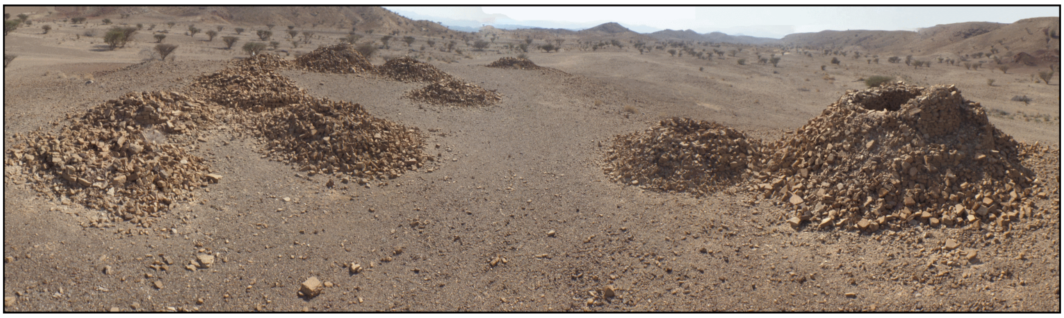


Figure 6.28: Pole camera photomosaic of the main cluster of twelve Hafit tombs at al-Hamid

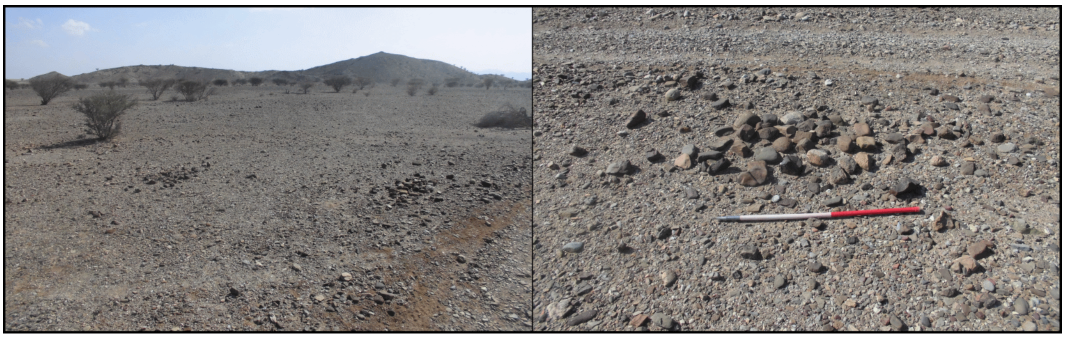


Figure 6.29: Examples of ephemeral stone features on terrace below the Hafit cemetery at al-Hamid

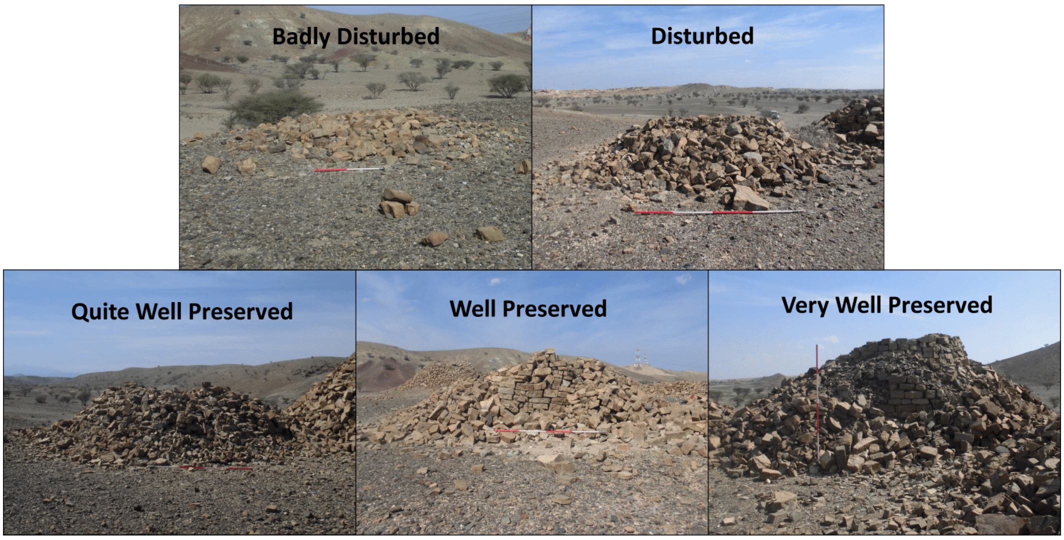


Figure 6.30: Examples of the condition of Hafit tombs at al-Hamid

Table 6.11: Preservation of tombs at al-Hamid

	Hafit Tombs
very well preserved	2
well preserved	1
quite well preserved	8
disturbed	1
badly disturbed	1
TOTAL	13

The Hafit tombs at al-Hamid are constructed in a similar fashion. The chosen material is the local rock — blocks and thick slabs of angular, yellow Hawasina silt stone that are mostly unworked or only very roughly worked. The majority of the tombs appear to have two or three concentric ring-walls, but the two largest appear to have four. The space between the ring-walls is packed with stones that are smaller and more irregularly angular than those used in the walls. The outer walls of the tombs are smooth. In most cases this was achieved through the careful selection — and possibly some very rough working — and fitting of the blocks and slabs used in the walls. However, in the largest tomb (HMD-02) at least some of the blocks and slabs appear to have been hewn into a rough trapezoidal shape to achieve a more precise fit, and in this and one other tomb (HMD-12) small plugging stones of the same material were used to fill gaps in the wall face (Figure 6.31).

Figure 6.31: Variation in tomb facing at al-Hamid — use of trapezoidal blocks and plugging stones in centre and right

Entrances are visible, or possibly visible, in the walls of four of the thirteen tombs at al-Hamid (Table 6.12, Figure 6.32). In two cases they are trapezoidal — with sideways corbelling of stones topped by a lintel — while their shape is unclear in the two other tombs as only the sides of the entrances are visible between the collapsed rubble. The orientation of the entrances vary significantly from southeast to north.

Figure 6.32: Examples of clearly visible and possibly visible entrances in Hafit tombs at al-Hamid

Table 6.12: Entrances in Hafit tombs at al-Hamid

	Entrance	Shape	Orientation (°)
HMD-02	clearly visible	trapezoidal	145
HMD-04	possibly visible	trapezoidal	320
HMD-07	possibly visible	only sides visible	242
HMD-13	possibly visible	only sides visible	4

The Hafit tombs at al-Hamid are all circular or sub-circular — the aspect ratio of the most oblate is less than 10:9, but most are less than 20:19. The diameters of the tombs vary considerably (Table 6.13): the smallest is 4m; the largest is 10m (Figure 6.33); while the majority are between 5 and 6.5m. The standing height of the tombs depends on their condition and size (Table 6.14): the largest is almost 4m tall; the 'badly disturbed' tomb stands only 20cm high; but the majority is between 1.2 and 1.8m in height.

Table 6.13: Dimensions of Hafit tombs at al-Hamid

Tomb	Length (m)	Width (m)
HMD-02	10.0	10.0
HMD-12	7.0	7.0
HMD-04	6.6	6.5
HMD-06	6.4	6.2
HMD-11	5.9	5.7
HMD-05	5.5	5.4
HMD-07	5.5	5.2
HMD-09	5.4	5.2
HMD-13	5.2	4.8
HMD-08	5.1	4.9
HMD-10	5.1	4.9
HMD-03	4.7	4.7
HMD-01	4.2	3.8

Table 6.14: Standing height of Hafit tombs at al-Hamid

Condition	Tomb	Diameter (m)	Height (m)
very well preserved	HMD-02	10.0	3.8
	HMD-12	7.0	3.1
well preserved	HMD-11	5.9	1.8
quite well preserved	HMD-13	5.2	1.7
	HMD-04	6.6	1.6
	HMD-06	6.4	1.4
	HMD-05	5.5	1.3
	HMD-09	5.4	1.3
	HMD-08	5.1	1.3
	HMD-07	5.5	1.2
	HMD-10	5.1	1.2
disturbed	HMD-03	4.7	0.8
badly disturbed	HMD-01	4.2	0.2

Figure 6.33: HMD-02 — the uniquely large Hafit tomb at al-Hamid

6.5 Discussion

Halban, Wadi al-Hoqain and al-Hamid are not typical Batinah Hafit sites, but they show numerous similarities that could provide insight into the development of Hafit society and funerary practices. The preservation of the Hafit tombs at these three sites is remarkable — it is clearly superior to any of the dozens of the other cemeteries visited over the course of this PhD project. To some extent this is the result of the architecture of the tombs at these sites — a second characteristic that makes these cemeteries special. Although different building materials were used at each site — Tertiary slabs and blocks, Hawasina slabs and blocks, and a combination of wadi cobbles and angular pieces of ophiolite bedrock — the care and skill shown in the selection and placement, and in some cases the working, of the stones is exceptional (Figure 6.34). At each of the three sites this has culminated in massive Hafit tombs that are extraordinary, both in the context of the Batinah and the northern Oman Peninsula as a whole (Figure 6.35).

Halban, Wadi al-Hoqain and al-Hamid notably share other characteristics that are worthy of comment. All three sites are advantageously located to exploit water and copper ore (Table 6.15) — the two resources that stood out as the most important in the spatial analyses of the B-GE survey results (Chapter 5.4.4). Al-Hamid is located only a hundred metres from two channels of a small wadi, and is only a few hundred metres

Figure 6.34: Examples of high quality Hafit tomb facing at Wadi al-Hoqain, al-Hamid and Halban

Figure 6.35: The largest Hafit tombs at Wadi al-Hoqain, al-Hamid and Halban

from a much larger watercourse. Although the drainage area of this wadi is smaller than the Hafit tomb and landscape control mean values, the site is only half a kilometre from the Tertiary aquiclude which is significantly closer than the tomb and landscape averages. Moreover, this Tertiary outcrop is one of the tallest and broadest in the Batinah. Not only is al-Hamid less than three kilometres away from the nearest copper ore source, much closer than the Hafit tomb and landscape control mean values, but this ophiolite deposit includes a major stockworks that is rich enough to warrant modern mining and for which there are plans to start in the near future.

Table 6.15: Nearby hydrology and geology in Halban, Wadi al-Hoqain and al-Hamid compared to Hafit tomb and landscape mean

	Landscape Mean	Hafit Tomb Mean	al-Hamid	Wadi al-Hoqain	Halban
Drainage area of largest nearby wadi (sq-km)	89	100	41	648	101
Distance to nearest sizeable wadi (km)	1.04	0.67	0.17	0.11	0.14
Distance to Tertiary aquiclude (km)	19.4	7.1	0.5	7.4	2.2
Distance to copper ore source (km)	8.4	4.8	2.8	0.7	1.8

Wadi al-Hoqain is located only metres from a very large wadi channel that drains an area many times larger than the Hafit tomb and landscape control mean values, making up for the fact that it is a little further from the nearest Tertiary aquiclude outcrop than the average Hafit tomb. The site is also very close to a known source of copper ore, only 700 metres away. Halban is well situated with regards to hydrology: it is within 200m of two small streams; only one kilometre from a more sizeable watercourse that is slightly larger than the Hafit tomb mean value, and significantly larger than the landscape control average; and it is only 2.2km from the nearest outcropping of the Tertiary aquiclude — much closer than the average tomb or the Batinah landscape as a whole. It is also much closer to a source of copper ore than the Hafit tomb and landscape control mean values. Furthermore, it is possible that the ophiolite bedrock on which the tombs sit contains veins of copper minerals (Figure 6.36).

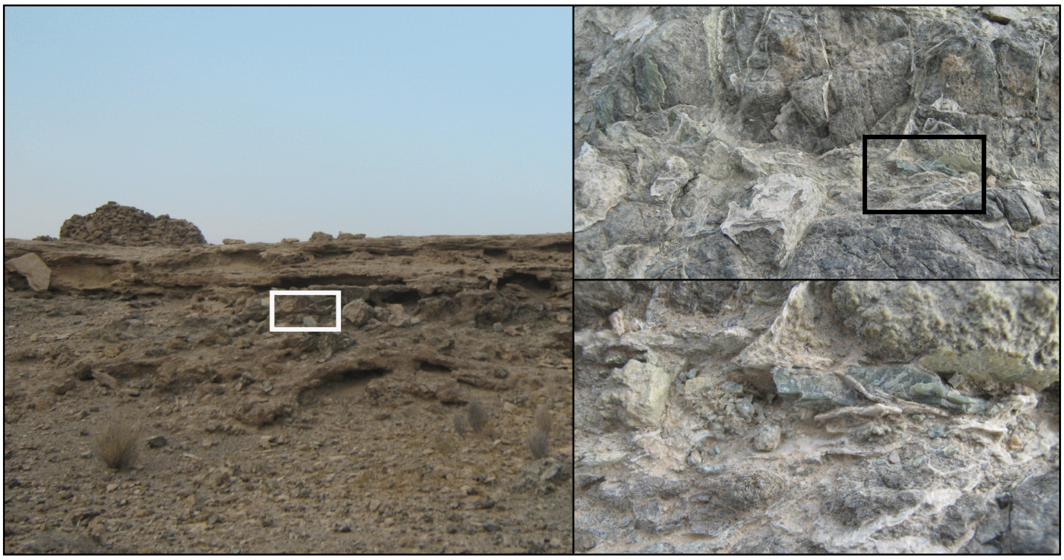


Figure 6.36: Possible veins of copper ore minerals in the underlying ophiolite of the Hafit tomb terrace at Halban

Each of the three sites is very advantageously positioned to exploit water resources — either through wadi channels, the Tertiary aquiclude, or both — and all three are found considerably closer to a source of copper ore than the average Hafit tomb and the Batinah landscape as a whole. Their position in the landscape would have made these sites extremely attractive to the Hafit population.

The three cemeteries also share other similarities, including the variation in their Hafit tombs. Although some of the tombs show considerable sophistication in terms of their architecture and stone-working, not all are so ostentatious. With regards to their size, only one tomb at each of the three sites is very large, the others are of much more normal proportions (Table 6.16, Figure 6.37).

Table 6.16: Varying Hafit tomb size at Halban, Wadi al-Hoqain and al-Hamid

	Halban	Wadi al-Hoqain	al-Hamid	Dimensions
Very Small	2 (7.7%)	2 (33.3%)	-	Length <4m
Small	18 (69.2%)	-	2 (15.4%)	4m <= Length <5m
Medium	5 (19.2%)	1 (16.7%)	7 (53.8%)	5m <= Length <6m
Large	-	2 (33.3%)	3 (23.1%)	6m <= Length <8m
Very Large	1 (3.8%)	1 (16.7%)	1 (7.7%)	Length >= 8m
TOTAL	26	6	13	

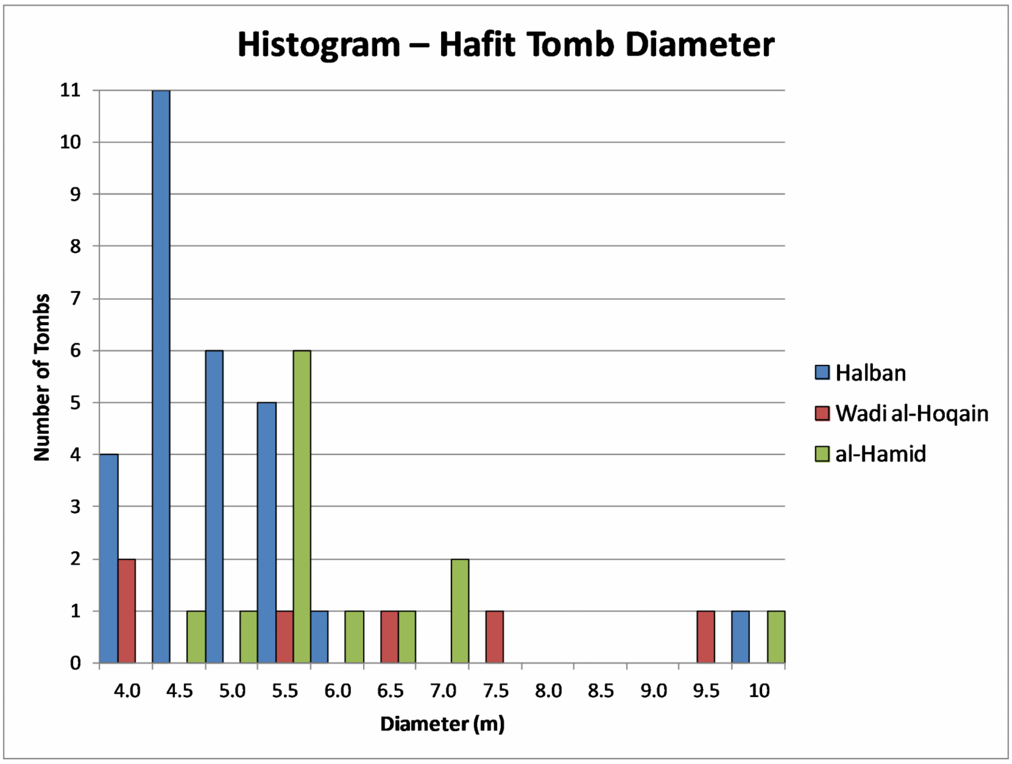


Figure 6.37: Histogram of the diameter of tombs at Halban, Wadi al-Hoqain and al-Hamid

Similarly, while considerable effort was taken to face some of the tombs at Halban, Wadi al-Hoqain and al-Hamid, in the majority of cases the structures are only roughly faced (Table 6.17).

Table 6.17: Outer wall facing of Hafit tombs at Halban, Wadi al-Hoqain and al-Hamid

	Halban	Wadi al-Hoqain	al-Hamid	Description
crude	16 (61.5%)	4 (66.7%)	10 (76.9%)	Carefully selected flat stones, producing an almost smooth outer wall face
careful	10 (38.5%)	1 (16.7%)	2 (15.4%)	Very carefully selected, or slightly worked, flat or curved stones, with frequent smaller plugging stones, producing a smooth outer wall face
n/a	-	1 (16.7%)	1 (7.7%)	Tomb too disturbed to assess facing
TOTAL	26	6	13	

In the vicinity of two of the sites there is evidence for insubstantial settlement remains — shallow wadi cobble and angular slab features that are difficult to interpret. At Wadi al-Hoqain these features are located throughout the site, sharing the terrace with the tombs. They are grouped in three main clusters — north of the northernmost tomb, between it and the middle group of tombs, and stretching from the northeast to the south of the two southernmost tombs. They are irregular, straight and curved alignments of wadi cobbles, from fifty centimetres to several metres across in size, as well as small piles and arrangements of rocks. Their function is unclear, but they may well constitute the remains of temporary campsites after the more perishable materials have degraded or been removed. No pottery or lithics were observed in and around these insubstantial structures. At al-Hamid similar cobble and angular stone features are present, located across a sizeable terrace below and to the northeast of the tombs' hillock. Red and green chert debitage, that may or may not be anthropogenic, was noted in this area, but no clear examples of lithic tools were observed and this material could easily pre-date the Hafit period. Although the features cannot be dated, their presence at both sites, their similarity, and the lack of associated pottery or quality lithics provide circumstantial evidence for contemporaneity with the tombs. The lack of similar structures in the vicinity of Halban does not necessarily suggest that they were never present. Modern farming and building plots stretch to the base of the Tertiary terrace — this part of the plain may once have boasted similar features that are now destroyed or obscured.

What does the survey of these three Hafit cemeteries reveal about the nature of Hafit society? In many ways the results underline the conclusions drawn out of the B-GE survey (Chapter 5.5). A strong emphasis on access to water is apparent — either through the Tertiary aquiclude or major wadi channels — as well as sources of copper ore. All three sites are located less than 200m from a watercourse and within 2.5km of either a Tertiary outcrop or a major wadi, and all are less than 3km from a known source of copper ore. The placement of the Hafit tombs on terraces and hillocks highlights territoriality in Hafit society — the use of tombs to mark areas that provide access to valued resources. The insubstantial settlement features at Wadi al-Hoqain and al-Hamid suggest that the Hafit population was nomadic or semi-nomadic. Their construction of massive tombs clearly demonstrates that the population had the skills and knowledge to build with stone, but only puzzling rock alignments and stone piles remain nearby, suggesting that domestic units mainly consisted of organic material, and may well have been temporarily erected as campsites. The orientation of the tomb entrances provide new insights. At Halban six of the 26 Hafit tombs have surviving entrances, and all point towards approximately south-east; in contrast the three tomb entrances at Wadi al-Hoqain and the four at al-Hamid are much more varied in their orientation (Figure 6.38). None of the entrances at any of the sites clearly point towards a natural or anthropogenic feature in the surrounding landscape. The consistency in tomb entrances at Halban may be arbitrary or coincidental, or they may relate to the position of the sun — i.e. have been constructed to point either towards sunrise or away from sunset. If this is the case, then it suggests that Halban was only visited by Hafit populations during either the summer — if away from sunset — or the winter — if towards the sunrise. Either way it suggests that the Hafit population in this part of the Batinah was not only nomadic, but seasonally nomadic. With regards to Wadi al-Hoqain and al-Hamid, no such suggestions may be made as the orientation of the entrances bears no obvious relationship to the solar azimuth. However, the differences in Hafit tomb entrance orientation, despite overall similarity in tomb architecture, may suggest intraregional variation in funerary practices or belief systems — a uniform material culture does not necessarily signify identical ideology (cf. Deadman 2014).

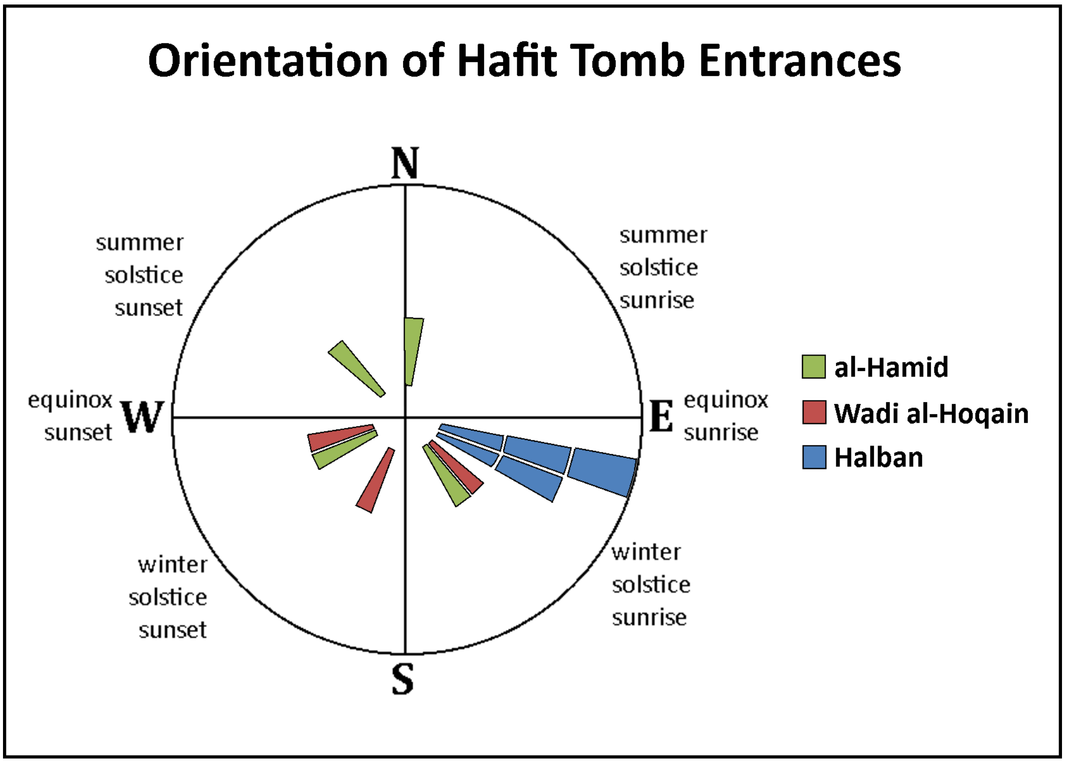


Figure 6.38: 'Windrose' chart of the orientation of Hafit tombs at Halban, Wadi al-Hoqain and al-Hamid

The tombs of Halban, Wadi al-Hoqain and al-Hamid may also provide insight into the development of Early Bronze Age funerary practices and socio-economic structures. Each of the three sites appear to demonstrate chronological development in funerary architecture. The size of the tombs appears, generally, to have increased over time. At both Wadi al-Hoqain and al-Hamid, the smallest Hafit tombs are in the worst condition — it is not unlikely that either the stone from these structures was used to build later, larger structures, or that the earliest, smallest, least well-constructed tombs survived the least well over time. At both of these sites, the larger the tomb, the better its condition, with the very largest tombs being the best preserved (Figure 6.39). At Halban the pattern is not as clear — for reasons that will be explored below — but nonetheless, the tombs in the worst condition are some of the smallest at the site.

As well as an increase in size, the quality of the facing of the outer walls of the tombs appears to have improved over time. At Wadi al-Hoqain and al-Hamid, the best preserved tombs have the most sophisticated facing, they are also generally the largest. At Halban the situation is not as simple. The largest tomb has the cruder facing along with the majority of the smaller and medium structures. The better facing is only seen in small and

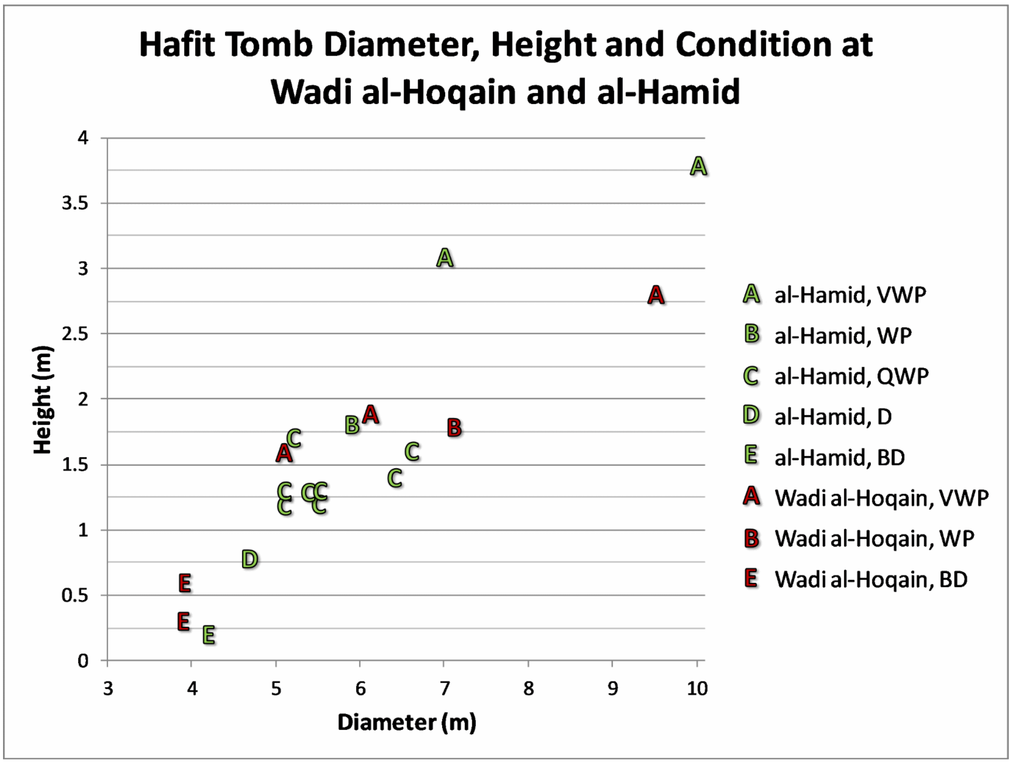


Figure 6.39: Graph of Hafit tomb diameter, height and condition at Wadi al-Hoqain and al-Hamid

medium tombs, while the two early Umm an-Nar tombs have characteristic ‘sugarlump’ facing stones. Logically if outer wall facing improved over time — culminating in the two early Umm an-Nar structures — then Halban’s largest tomb cannot be one of the latest. At Halban the two architectural variables seem not to show simple correlation, rather the chronology may have been from small crude tombs, to medium crude tombs, to the very large crude tomb, to medium well-faced tombs, to medium Umm an-Nar tombs. This may have the simple explanation that such very large tombs would have proved too costly to face so carefully. It is possible that the three sites are not exactly contemporary, and that the medium, well-faced tombs at Halban are from very late on the Hafit period, and that tombs were not built at al-Hamid and Wadi al-Hoqain during this phase. Halban is located where the Batinah plain is most narrow and is the only site that neighbours a traditional agricultural settlement, and that boasts Umm an-Nar tombs — possibly by this late point of the Hafit period the original Wadi al-Hoqain and al-Hamid populations had moved further inland to the areas of the main Batinah zone for Umm an-Nar occupation (Kennet, Deadman, et al. 2016).

The funerary archaeology of the three cemeteries may also testify to other economic changes that took place in Batinah Hafit society. The density of the Hafit tombs at the three sites is unusual — GIS analysis of tomb spatial distribution demonstrated that Hafit tombs generally have few neighbours at short range — within 100m — and that the

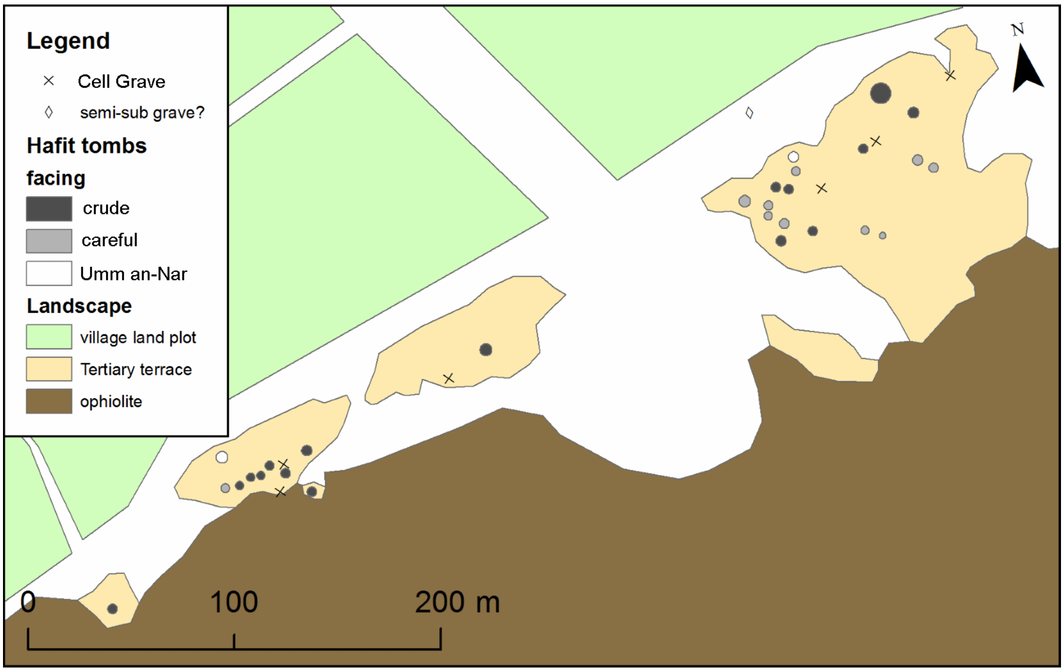


Figure 6.40: Map of the diameter and facing of Hafit tombs at Halban

average number of tombs per cluster is only 2.9; a significant minority have no neighbours within 100m (Chapter 5.4.3). The site of Wadi al-Hoqain is quite typical: two of the six tombs have no neighbouring Hafit structure within 100m, while the middle group consists of a small cluster of four tombs. However, what is unusual about the site is its isolation: the vast majority of Hafit tombs in the area are located several kilometres to the north, in the bajada zone and much nearer the Tertiary aquiclude — this makes the density of this lonely Hafit cemetery significant. Halban and al-Hamid are different. At al-Hamid all thirteen tombs are located within 100m of one other, forming a single cluster of 13 near neighbours and moreover, twelve of the thirteen are within 50m of each other. Similarly at Halban, all of the tombs are located within 100m of another, and the majority form one of two large clusters of 8 and 16 structures that are only metres from their nearest neighbours. The large number and the density of the Hafit tombs at these sites suggests that they were of particular importance, and were repeatedly visited, presumably for a specific purpose. Furthermore, the increasing size and sophistication of the facing of the tombs suggests that longer periods of time were spent at these sites at each subsequent visit. Significantly, the tombs at these cemeteries are not situated on the highest ground available in the local area — despite the presence of taller hills in their immediate vicinity — instead they are located on elevated, but not lofted positions on hillocks and terraces. This may suggest that there was diminishing need to proclaim ownership of the sites as the population was present more frequently. The proximity to copper ore is one explanation for the unusual characteristics of these three sites — all of which are located at a very short distance from a source of ore and have access to at least one major water source. This may testify to a development in economic strategy during the Hafit period — the targeting and repeated occupation of specific locations where copper ore may be easily exploited. This may suggest the increasing importance of the metal to Hafit society, either for domestic consumption or for international and local trade and exchange. The increasing sophistication of the tombs also hints at the emergence of specialisation in Hafit society — individuals who took charge and organised the construction of increasingly complex funerary monuments, and later individuals with the fine masonry skills to shape the convex facing stones at Halban.

It is logical to suggest that these changes in Hafit funerary architecture and the Early Bronze Age economy ran in parallel to developments in social organisation. A simplistic interpretation of increasing sophistication of the tomb architecture is increasing stratification in Hafit society. The emergence of elite individuals or families, gaining power and influence — feasibly through control of local or international copper trade — may be reflected in the burial architecture, with the elite interred in impressive monuments and the majority in smaller and lower quality funerary structures. Alternatively, it is possible that the society remained egalitarian throughout the Hafit period and the lifetime of these three sites — that these tombs were collective, to be used by every member of the population, and their growing sophistication reflected the increasing experience and skills in the group as a whole, as well as changes in how the population occupied the sites. Without excavation of the tombs at these sites, the interpretation of the funerary structures remains conjecture.

Many of the difficulties involved in interpreting change in Hafit society that may have accompanied the development of Halban, Wadi al-Hoqain and al-Hamid are chronological — it is impossible to know the relative and absolute dating of the tombs, and the period of occupation of these sites. This may span much of the ~700 year Hafit period, only cover its later phase, or may vary between the three sites. Without knowing which tombs were in use when and for how long, it is difficult to chart the course of the architectural developments, and the nature of the economic and social changes that accompanied them. If the tombs were constructed over a relatively short timespan at the end of the Hafit period, with both sophisticated and more modest structures in use at the same time, then a picture emerges of quite intensive exploitation of copper resources for trade, organised and controlled by an elite echelon of the population. However, if the sites were occupied for a long period, with only one or two similar tombs in use at any one point, then the obvious interpretation is of a lower intensity occupation of the site and the nearby copper resources, by a small and egalitarian Hafit population that constructed increasingly sophisticated collective funerary monuments for use by every member of the group. Until further research is carried out at these sites, or similar Hafit cemeteries, the precise nature of the developments in Hafit funerary architecture, economy and social structures will remain a mystery.

6.6 Conclusion

Ground-based fieldwork forms a critical part of this thesis, adding an additional, high-resolution level of detail to the findings of the NOP-GE and B-GE surveys, and the emerging picture of Hafit society. Surveys were carried out at three Hafit cemetery sites in the southern half of the Batinah. Halban is located on the eastern border of the Batinah, a cemetery of Hafit tombs and LPTs spread over a number of Tertiary terraces on the periphery of a modern village. Wadi al-Hoqain is an isolated site in northern al-Rustaq — a small, mixed cemetery of mainly Hafit tombs situated on the western bank of a major watercourse. Al-Hamid is in the *wilaya* of al-Khaburah, and consists of a small hillock with thirteen Hafit tombs distributed across its southern half. Each of the tombs at these three sites was recorded: GPS coordinates were noted; photographs were taken; and a record sheet was filled out for each noting the location, architecture and dimensions of the funerary structures. Fifty-five tombs were recorded in total from the three sites. Halban boasts 26 Hafit tombs, 6 later Cell Graves, two early Umm an-Nar tombs and one possible Islamic grave. Wadi al-Hoqain consists of 4 Hafit tombs, 2 badly disturbed probable Hafit tombs and 1 round LPT. Thirteen Hafit tombs were recorded at al-Hamid. The remains of insubstantial settlement remains was noted at the latter two sites.

The results of this survey demonstrate that these are three special cemeteries, atypical of Hafit funerary sites in the Batinah. They are located in very close proximity to sources of copper ore and major supplies of water. The variation in their Hafit tomb architecture is also unusual — one structure at each site is of very large proportions, and special effort was made in facing a small minority of the tombs. The tombs and insubstantial settlement provide circumstantial evidence for a nomadic or semi-nomadic Hafit population; the orientation of the entrances at Halban may suggest that occupation of the site was seasonal, while the very different orientations of the tomb entrances at Wadi al-Hoqain and al-Hamid may suggest regional ideological differences in Batinah Hafit society. The funerary archaeology at the three sites hints at chronological developments in funerary architecture, with changes in tomb diameter and outer wall facing; the Hafit economy, with increasing sedentarisation and a growing significance of copper; and social structures, with either the emergence of an elite echelon, or the galvanisation of the original egalitarianism. The difficulties in interpreting these developments are the results of our lack of knowledge of the relative and absolute chronology of the three sites, which may only be resolved through excavation.

This fieldwork represents a major advancement in our knowledge of the Hafit period in the Batinah and the wider area. The detailed survey of Hafit tombs at three sites significantly expands our understanding of Hafit funerary architecture in the region. The three largest tombs recorded during this work are probably the most massive Hafit funerary structures yet known in the northern Oman Peninsula. The locating of two suspected Hafit campsite areas at Wadi al-Hoqain and al-Hamid makes a substantial addition to the list of possible settlements. Tentative evidence for the stratification of society during the Hafit period is unique.

This chapter provides extra detail to the picture of Hafit society generated through the NOP-GE survey (Chapter 4), and B-GE survey (Chapter 5). Although the suspected Hafit settlement remains could not be investigated at these three sites, the following chapter examines an even more promising possibility located early on in the project.

Chapter 7

The Desert Surface Survey: attempting to locate Hafit settlement evidence at al-Buyraq

7.1 Introduction

Through the analysis of the distribution and architecture of Hafit tombs considerable light has already been shed on the nature of Hafit society in the Batinah and in the northern Oman Peninsula as a whole. This chapter focuses on locating and analysing Hafit settlement remains, adding even greater detail to the picture of the Hafit population already derived through an examination of the tombs of the period. Furthermore, the study of Hafit settlement remains would allow the conclusions already reached regarding the nature of Hafit occupation of the landscape — based purely on funerary archaeology — to be tested. Very few possible Hafit settlements are known, and locating such archaeological evidence is not straightforward; to provide the best possible opportunity efforts were concentrated on a single site, further narrowing the geographical focus of the project.

While this research attempts to move away from funerary archaeology, studying the distribution of Hafit tombs was vital in locating and selecting a suitable settlement survey site. While conducting other fieldwork, a promising candidate was discovered. Al-Buyraq is a Hafit cemetery site approximately 4km north-northeast of the eponymous modern village, which lies in the northern part of the *wilaya* of Rustaq, close to the border with Suwaiq (Figure 7.1). The topography forms a natural bowl, approximately 500m across, with low 10–15m hills of Quaternary fluvial material bordering the site on all but the northern side. Over eighty Hafit tombs are located on these hills, forming part of a massive cemetery many hundreds strong that covers the wider range of hills that stretch in all directions. The bowl's base consists of lower, undulating terrain — a deflated desert pavement of darkly patinated wadi cobbles. It has a small streambed running through it that drains an area of 5 sq-km, as well as two small tributaries. This wadi joins a slightly larger channel ~2km north of the site, that drains an area of just over 20 sq-km; a much larger wadi with a 250 sq-km catchment area lies 4km east of the site across low Quaternary hills. Some sizeable Tertiary outcrops — part of the Batinah aquiclude — are located less than 4km downstream to the northeast. The site is located just over three kilometres from the centre of a large body of copper ore in the ophiolite hills to the south; other known sources are situated within 10km of the site to the northwest.

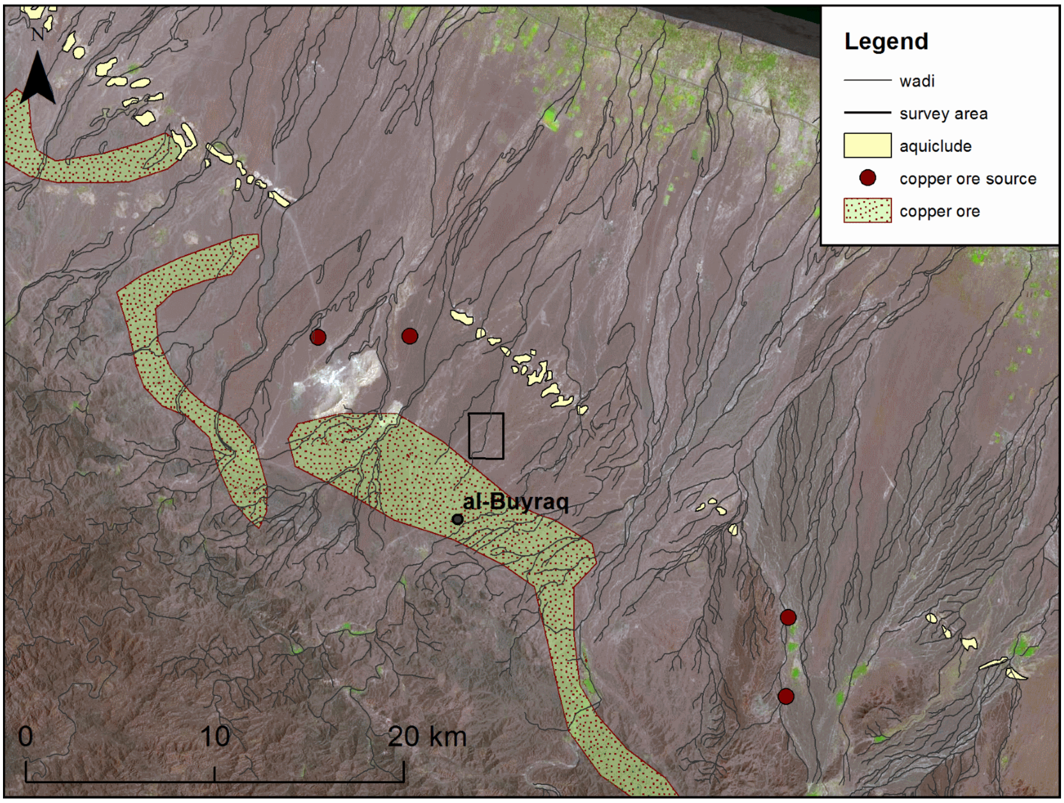


Figure 7.1: The location of the site of al-Buyraq, as well as the modern village, and the hydrology and geology of the area

The location and topography of al-Buyraq make it an eminently suitable site for a survey for Hafit settlement remains (Figure 7.2). The bowl-like topography forms a discrete area that is suitable for detailed survey, while the strong presence of Hafit tombs on the surrounding hills and in the wider area strongly suggests significant Hafit occupation. The small wadi would have been attractive to an Early Bronze Age population, as would the proximity of the aquiclude, copper ore and a much larger wadi which are all located within a few kilometres of the site.

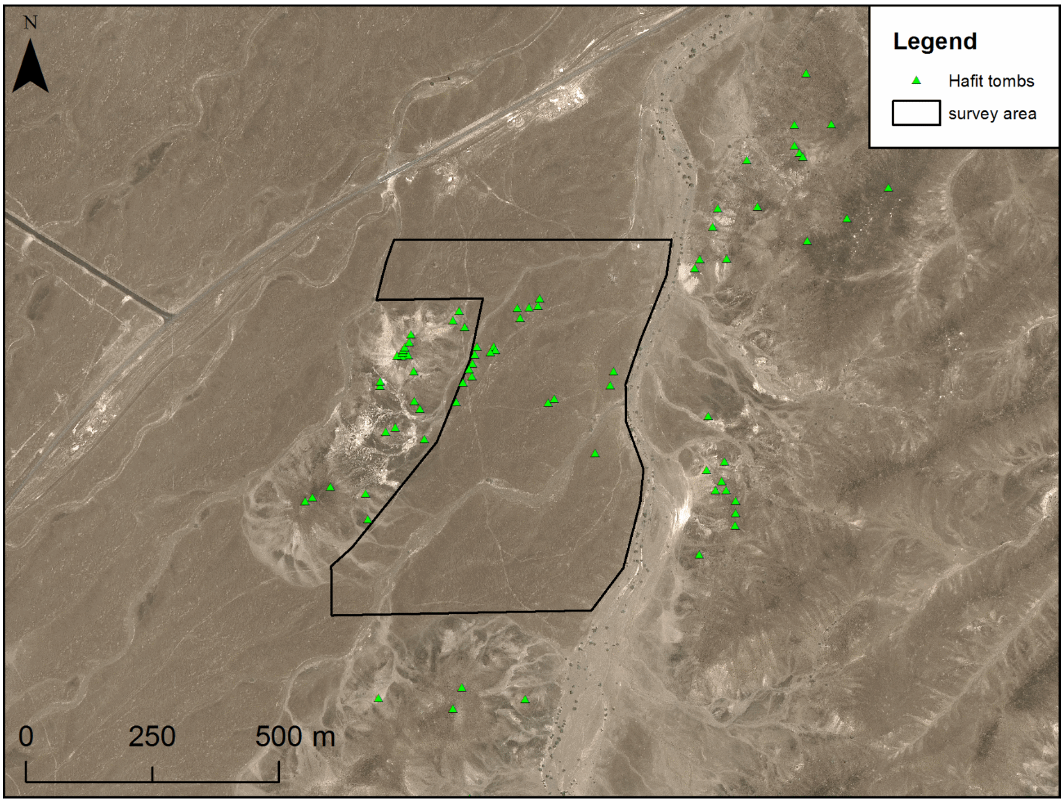


Figure 7.2: The topography and Hafit funerary archaeology of the Desert Surface Survey area at al-Buyraq

The Desert Surface Survey (DSS) forms the foundation of the archaeological investigations at al-Buyraq — a highly detailed transect-based survey of the 30 hectare 'bowl' in which the location and form of any visible, suspected surface archaeology was recorded and any surface finds were collected. The most promising of the features noted during the DSS were recorded in greater detail in a second phase of fieldwork. The details of the method and findings of these two phases of survey are presented below, followed by analysis and discussion of the results. However, firstly some brief background information will be provided.

7.2 Background

The concept of analysing the distribution of Hafit tombs to locate contemporary settlements was first discussed by Giraud and the Joint Hadd Project. The team found ephemeral structural remains such as "hearths, circular and semi-circular structures, rectangular structures, and alignments" in flat areas surrounded by hills with Hafit tombs, and suggested that the distribution of the tombs could be used to locate settlements associated with Hafit cemeteries (Giraud and Cleuziou 2009: 173). However, this present research represents the first attempt to locate Hafit settlement remains based on the distribution of the tombs in areas that are not already known to contain ephemeral stone features.

The methodology of the DSS is largely based on very similar fieldwork carried out by the Kadhima Project, investigating a large, insubstantial Early Islamic site in Kuwait (Kennet 2014). A 5.4 sq-km area was divided into transects and walked by a team spaced at 15m intervals, logging and recording any visible archaeological features and collecting surface finds. Promising areas and features identified were then subjected to more detailed evaluation (Kennet, Blair, et al. 2011: 167; Kennet 2014: 15–18). More broadly the survey also draws on seminal work by Cribb to record the archaeological remains of nomadic populations (1991), that has been further developed by others in the Near East (e.g. Rosen 2011a; 2003), and in Arabia (Lopez, Morabito, et al. 2015).

The fieldwork for this research was carried out during the first two seasons of the *Rustaq-Batinah Archaeological Project*, using the time, equipment and human resources of the RBAS team. Some early findings are included in two of the preliminary project reports (Kennet, al-Jahwari, Deadman, Mortimer, et al. 2015; Kennet, al-Jahwari, Deadman, and Mortimer 2014). As the team did not include a lithics specialist, chert surface finds from this research were kindly examined by Vincent Charpentier and his team, a noted Arabian Neolithic expert, and remotely by Dr Helen Drinkall, a lithics specialist at Durham University.

7.3 Method

The research methodology has three distinct phases: the DSS; secondary recording of the most compelling features; and examination of the ceramic and lithic assemblages.

The flat base of the bowl and an additional section stretching a short distance to the north was selected for survey. In total this is approximately 700 by 550m in size and 30 hectares in area. Points on the eastern and western boundaries of the survey area, spaced at 40m intervals were generated in ArcGIS and imported into handheld GPS units. Four people spaced 10 metres apart walked from each western boundary point to the corresponding eastern boundary point, or vice versa, directed by a GPS unit. When one of the walkers observed an archaeological feature, they placed a marker on the ground — a 500ml water bottle, partially filled and painted white to improve visibility (Figure 7.3). Two other people followed behind the line, collecting the markers, and logging each feature with a GPS waypoint and a brief descriptive note. As each transect was completed, the two recorders redistributed the markers, the four-person line moved north to the next waypoint, and the process was repeated. If surface finds were observed, the survey was halted and they were bagged and labelled. Any features that were remarkable in terms of their form or preservation, or which were fine examples of a frequently observed type, were underlined by the recorders and were later revisited and briefly recorded in greater detail with photographs, dimensions and a sketch plan. The survey took six people approximately 12 hours in total to complete.

Figure 7.3: Desert Surface Survey methodology — a 40m line of four students walking a 10m transect in unison

The most compelling of the features logged during the DSS were selected for further investigation. These features were photographed, measured, sketched and a plan of them was generated using the RBAS pole camera. Each feature was meticulously checked for surface finds by slowly walking 1m transects in a 10m square centered around it, as well as a 5 minute pickup in the immediately surrounding area. Test-pitting was trialled but abandoned once it became clear that the features were completely deflated — only a layer of natural fluvial sediments and the conglomerate bedrock underlies the desert pavement.

The possible lithic material collected during both stages of the fieldwork were examined by specialists in Muscat and Durham. The anthropogenic material was retained and described by the experts, and later photographed and drawn by the present author. The ceramics were examined and described by the RBAS pottery expert and were also photographed and drawn.

7.4 Results

7.4.1 Desert Surface Survey

In total, seventy-six transects spaced at 10m intervals were walked during the survey. 335 possible archaeological features were logged, and twenty-two special or exemplary features were revisited and briefly recorded. The 335 logged features may be divided into six broad groups based on the short notes written during the survey: absence features; curvilinear stone features; findspots; rectilinear stone features; small stone features; and stone scatters (Table 7.1, Figure 7.4). Twenty-two special or exemplary features were recorded in greater detail; they are presented as examples in the description of the features below.

Table 7.1: Number and percentage of features logged during the DSS by class and number of special/exemplary features recorded

	Features	Percent	Special/Exemplary
absence feature	16	4.8%	1
curvilinear stone feature	57	17.0%	10
findspot	5	1.5%	0
rectilinear stone feature	105	31.3%	4
small stone feature	142	42.4%	6
stone scatter	10	3.0%	1
TOTAL	335	100.0%	22

Over 40% of the features logged may be classed as ‘small stone features’ (Table 7.2). A sizeable majority of these — 89 of the 142 — were rough rings of stones ~1m across; approximately half of these formed a ring that was sufficiently tight, and with sufficient space in the centre, to resemble a simple hearth (Figure 7.5, left). A significant minority of this group was made up of rock piles — clearly arranged piles of stones, as large as a metre square and half a metre high — that have no clear function (Figure 7.5, centre). A similar proportion of the small stone features were stone ‘platforms’, denser than the desert pavement and diverse in shape. The most numerous were irregularly oval (Figure 7.5, right), and were large enough to cover a body in flexed position — resembling some Neolithic graves (e.g. Salvatori 2007) — although there was no clear evidence of them serving this or any funerary function. Round, square and semi-circular platforms were also observed.

Almost a third of the features recorded during the DSS may be described as ‘rectilinear stone features’ (Table 7.3). The vast majority of these features — over 80% — consisted of possible stone walls, with the certainty of identification varying. In some cases, these were tentatively described as lines of stones, while in others two wall

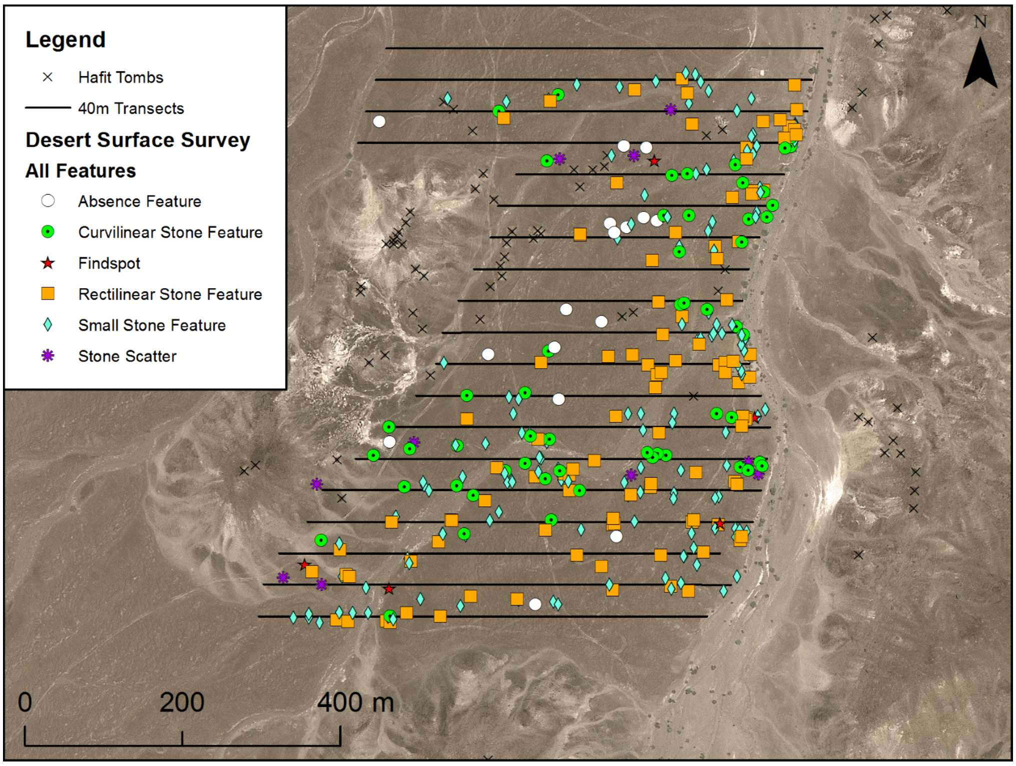


Figure 7.4: DSS results — logged features by class

Table 7.2: The number and percentage of 'small stone features' logged during the DSS and the number of special/exemplary features recorded

	Features	Percent	Special/Exemplary
large rock on silty ground devoid of other stones	1	0.7%	0
rock pile	23	16.2%	0
large square rock pile	1	0.7%	1
boulder pile	2	1.4%	0
rough ring of stones	44	31.0%	2
rough ring of stones - hearth?	41	28.9%	1
rough ring of stones with a white stone scatter	1	0.7%	0
3 rough rings of stones	1	0.7%	1
3 rough rings of stones - hearths?	1	0.7%	0
rough ring of boulders	1	0.7%	0
stone-lined hole	1	0.7%	0
rough jumble of stones - grave?	2	1.4%	0
stone platform	1	0.7%	0
small stone platform	1	0.7%	0
small stone platform?	1	0.7%	0
square stone platform	3	2.1%	0
square stone platform - grave?	1	0.7%	0
round stone platform	2	1.4%	0
small round stone platform	1	0.7%	0
rough oval stone platform - grave?	10	7.0%	0
rough oval stone platform & semi circle of stones - grave?	1	0.7%	0
rough oval stone platform & white stone scatter - grave?	1	0.7%	0
semi-circular stone platform with curved tail	1	0.7%	1
TOTAL	142	100.0%	6

Figure 7.5: Exemplary 'small stone features' recorded during the DSS: a ring of stones; a rock pile; and a stone platform

sections seemingly formed corners. It is likely that some of these 'wall' features are natural — either chance arrangements in the desert pavement, or the imbrication of stones related to fluvial activity, but many were convincingly anthropogenic. In a small number of cases, walls form small, insubstantial rectangular or square structures (Figure 7.6). In many cases these were poorly defined, with the precise layout very difficult to see, but in others the plan was much clearer.

Table 7.3: Number and percentage of 'rectilinear stone features' logged during the DSS and number of special/exemplary features recorded

	Features	Percent	Special/Exemplary
line of stones	10	9.5%	0
line of stones?	1	1.0%	0
series of lines of stones	1	1.0%	0
stone wall	19	18.1%	0
stone wall?	15	14.3%	0
stone wadi wall	2	1.9%	0
corner of stone wall	31	29.5%	0
series of stone walls	1	1.0%	0
boulder wall	4	3.8%	0
boulder wall?	1	1.0%	0
stone structure?	2	1.9%	0
boulder structure	2	1.9%	0
boulder structure?	1	1.0%	0
rectangular stone structure	4	3.8%	1
sub-rectangular structure	1	1.0%	0
10x1m rectangular feature	2	1.9%	1
square structure	2	1.9%	1
square structure?	3	2.9%	0
small square structure	1	1.0%	0
square stone, semi-sub structure?	1	1.0%	0
square structure with rock piles	1	1.0%	1
TOTAL	105	100.0%	4

More than a sixth of the features logged in the survey were classed as 'curvilinear stone features' (Table 7.4). The majority of these consist of rough semi-circles of stones up to a few metres across, some may be natural features, but many are clearly anthropogenic. Over 20% of this class is made up of rough circles of stones, and many boast rough stone rings and rock piles either on the inside or outside (Figure 7.7). A small number of curvilinear structures were observed — they are mostly described in

Figure 7.6: Stone walls and corners of two exemplary 'rectilinear features' recorded during the DSS

greater detail below as special features — including: two oval walled features with stone fills and headstones that could be graves, but which are not oriented according to *qibla*; three small curved structures that are conjoined; and a small, round turret-shaped feature that resembles a *gudrah* — a small pen for baby livestock.

Table 7.4: Number and percentage of 'curvilinear stone features' logged during the DSS and number of special/exemplary features recorded

	Features	Percent	Special/Exemplary
rough semi-circle of stones	29	50.9%	0
rough semi-circle of stones and area of devoid of stones	1	1.8%	0
rough circle of stones	1	1.8%	0
rough circle of stones?	1	1.8%	0
rough circle of stones with hearth?	5	8.8%	5
rough circle of stones with hearth? in centre	4	7.0%	3
small rough circle of stones	2	3.5%	0
rough curved wall	2	3.5%	0
rough curved wall?	5	8.8%	0
rough double wall of curved stones in wadi bed	1	1.8%	0
two short rough curved walls	1	1.8%	0
three curvilinear structures	1	1.8%	1
rough circular stone platform – robbed tomb?	1	1.8%	0
oval walled feature with stone fill – grave?	2	3.5%	1
small baby animal pen? – *gudrah*	1	1.8%	0
TOTAL	57	100.0%	10

'Absence features' make up almost 5% of the features logged during the survey (Table 7.5). They consist of areas, varying in shape and size, that are unusually devoid of large stones, giving the appearance of having been cleared. In many cases, these are roughly circular areas that are 4 to 5m in diameter found either in isolation or in small groups (Figure 7.8). In some cases they are associated with scatters of flakes of white stone. Another area forms a large band, much greater in size, and a further feature is less regular in shape. It is unclear how many of these features, if any, have actually been formed

Figure 7.7: Two examples of 'curvilinear features' recorded during the DSS — rough stone circles, with small stone features inside or nearby

through stone clearance. The numerous round features may be natural depressions that collect silt that obscures the underlying stones, or the 'shadows' of long dead trees that helped to retain sediments and break up stones.

Table 7.5: Number and percentage of 'absence features' logged during the DSS and number of special/exemplary features recorded

	All Features	Percentage	Special/Exemplary
area devoid of stones	1	6.3%	0
large banded area devoid of stones	1	6.3%	0
circular area devoid of stones	7	43.8%	0
circular area devoid of stones with a scatter of white stone flakes	3	18.8%	0
series of circular areas devoid of stones	4	25.0%	1
TOTAL	16	100.0%	1

Ten of the 335 features logged during the DSS may be classed as 'stone scatters' (Table 7.6). These consist of dense concentrations of a soft, exotic white stone and/or the local red-brown chert. Neither are clearly anthropogenic, but appear unusual in terms of their distribution. In most cases, these scatters were only up to a few square metres in size, in one case a slightly larger area of ~100 sq-m was logged, and another — recorded in detail below — was much larger (Figure 7.9).

Table 7.6: Number and percentage of 'stone scatters' logged during the DSS and number of special/exemplary features recorded

	All Features	Percentage	Special/Exemplary
scatter of small flakes of white stone	6	60.0%	0
scatter of small flakes of white stone & chert	2	20.0%	0
large scatter of small flakes of white stone	1	10.0%	0
very large scatter of small flakes of white stone & chert	1	10.0%	1
TOTAL	10	100.0%	1

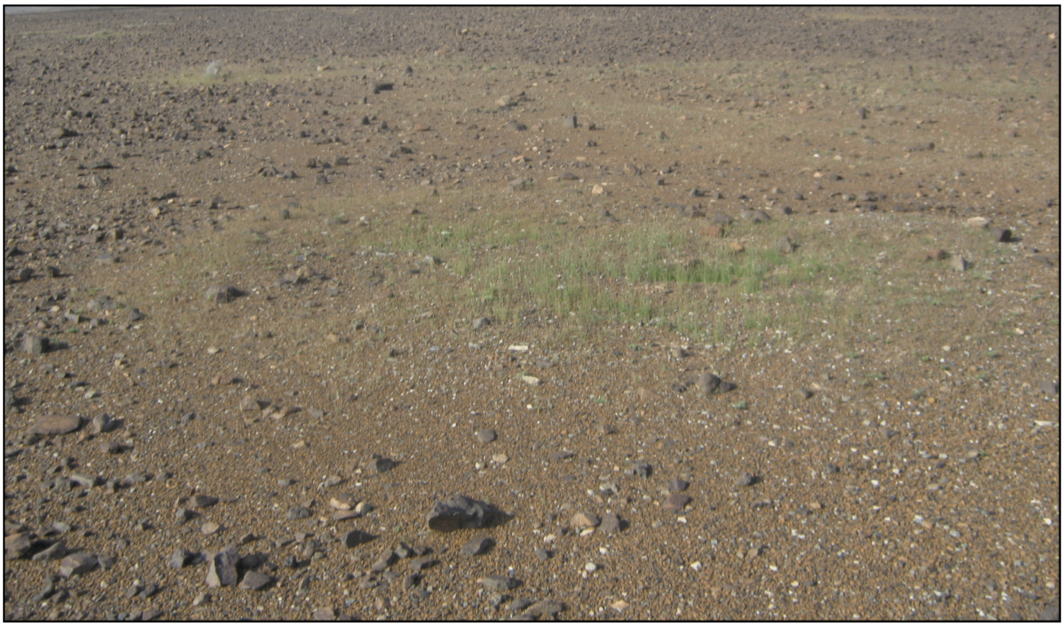


Figure 7.8: A series of 'absence features' — a number of overlapping circular areas devoid of large stones

Figure 7.9: Part of a very large scatter of flakes of white stone and local brown/red chert

In five cases, finds were picked up that were not associated with visible surface archaeology and so were recorded as 'findspots'. In one case, this was pottery, and in the other four, suspected lithics.

7.4.2 Recording a selection of the features

In the following season of the RBAS project, an additional stage of more detailed recording was carried out. Further investigations were concentrated on the group of features from the DSS that formed the most compelling evidence for human settlement — the rough stone circles or 'hut-circles' — with a selection of other special or exemplary features also being recorded in greater detail (Figure 7.10).

Eight 'hut-circles' were observed during the DSS, and were some of the most clearly anthropogenic features. They are distributed in three distinct clusters, in areas that boast a high density of DSS features. Six of the hut-circles are located within a very short distance

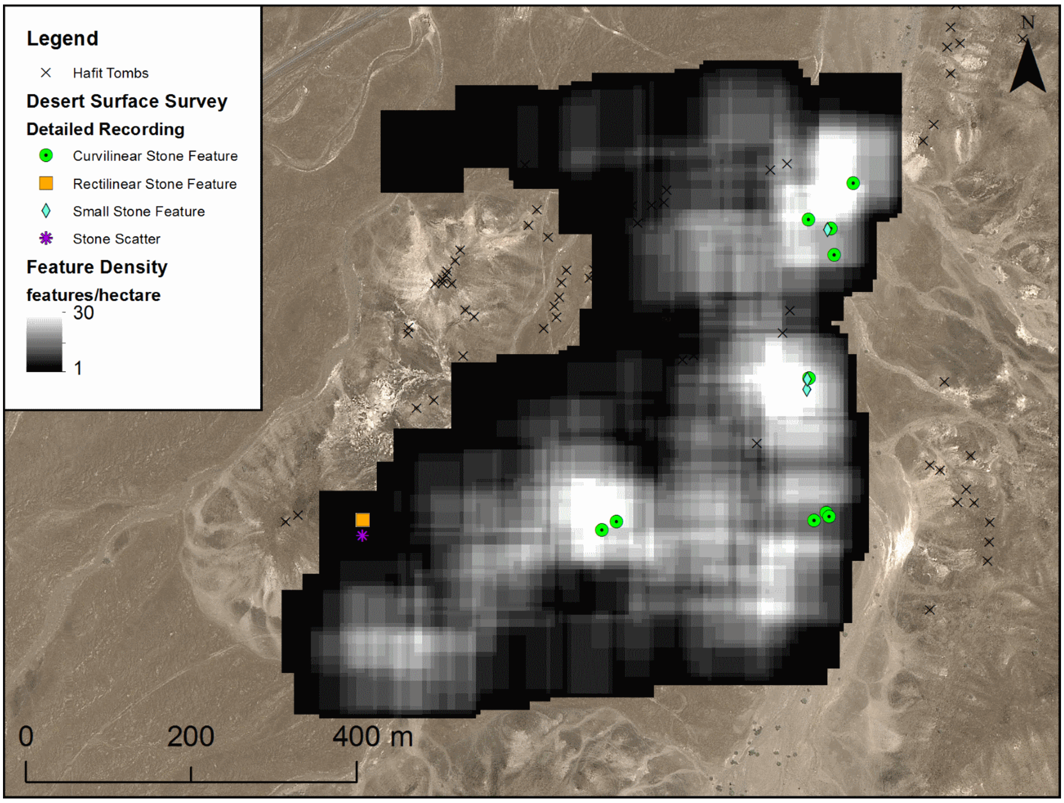


Figure 7.10: The features recorded in greater detail following the DSS

of the largest wadi channel in the area, and the other two are within close proximity to a smaller tributary stream (Figure 7.11). They are situated either on level ground — low plateaus overlooking a watercourse — or on a gentle gradient sloping towards a wadi or gully.

They consist of rough circles of ten to twenty large stones with a total external diameter of between 4 and 6m. The hut-circles frequently boast some kind of stone feature roughly in their centre, and rock piles, rough stone rings, and stone platforms are often found in their immediate vicinity (Table 7.7; Figures 7.12 & 7.13).

Table 7.7: Characteristic of the eight 'hut-circles' recorded

	Diameter (m)	Central Feature	Outer Feature	Notes
HC-1	5.9	rock pile		
HC-2	3.8		rock pile	
HC-3	5.8	rough stone ring; stone platform		a rock pile forms part of circle
HC-4	4.4	rough stone ring		
HC-5	5.9	rough stone ring		overlaps with HC-6
HC-6	4.9	rough stone ring		overlaps with HC-5
HC-7	5.0	partial rough stone ring	rock pile	
HC-8	5.0	rough stone ring	rock pile	

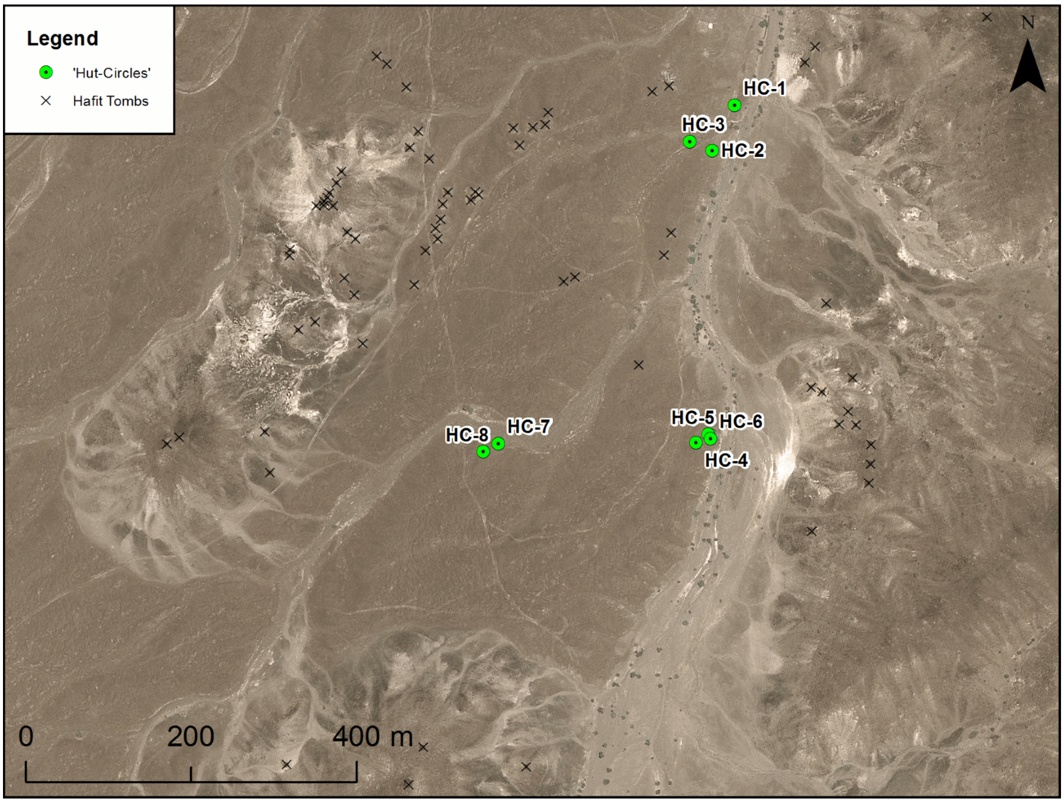


Figure 7.11: Location of the 'hut-circles' recorded

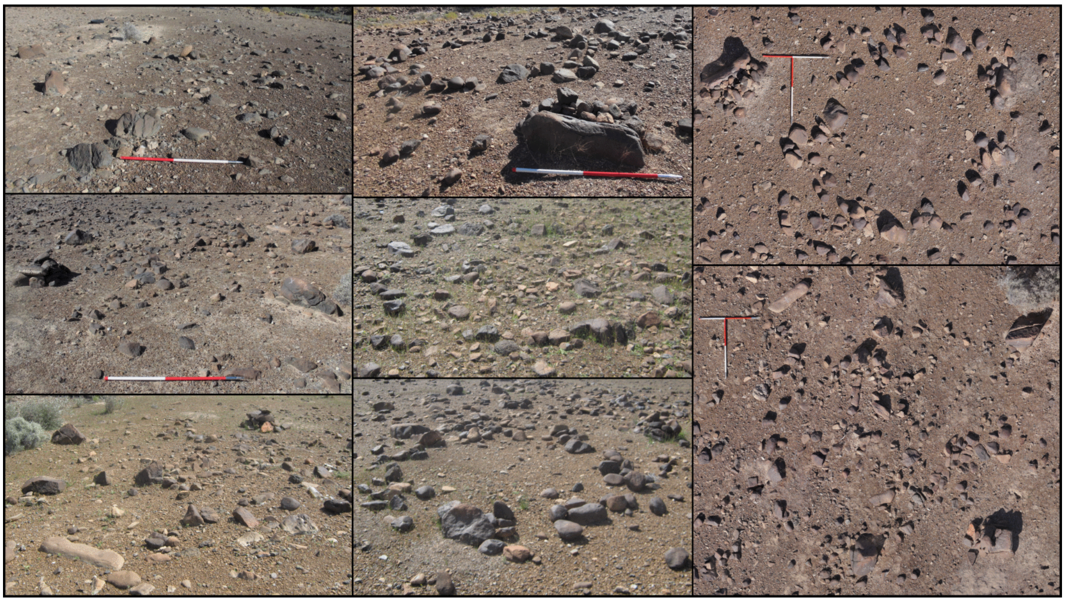


Figure 7.12: Selection of photos of the 'hut-circles' taken on the ground and using a pole camera

No pottery was found associated with any of the hut-circles, and — despite meticulous surface pickups — only two lithics were observed. A small core of average quality brown chert was found outside HC-3, and a larger core of a coarser stone was picked up outside HC-4.

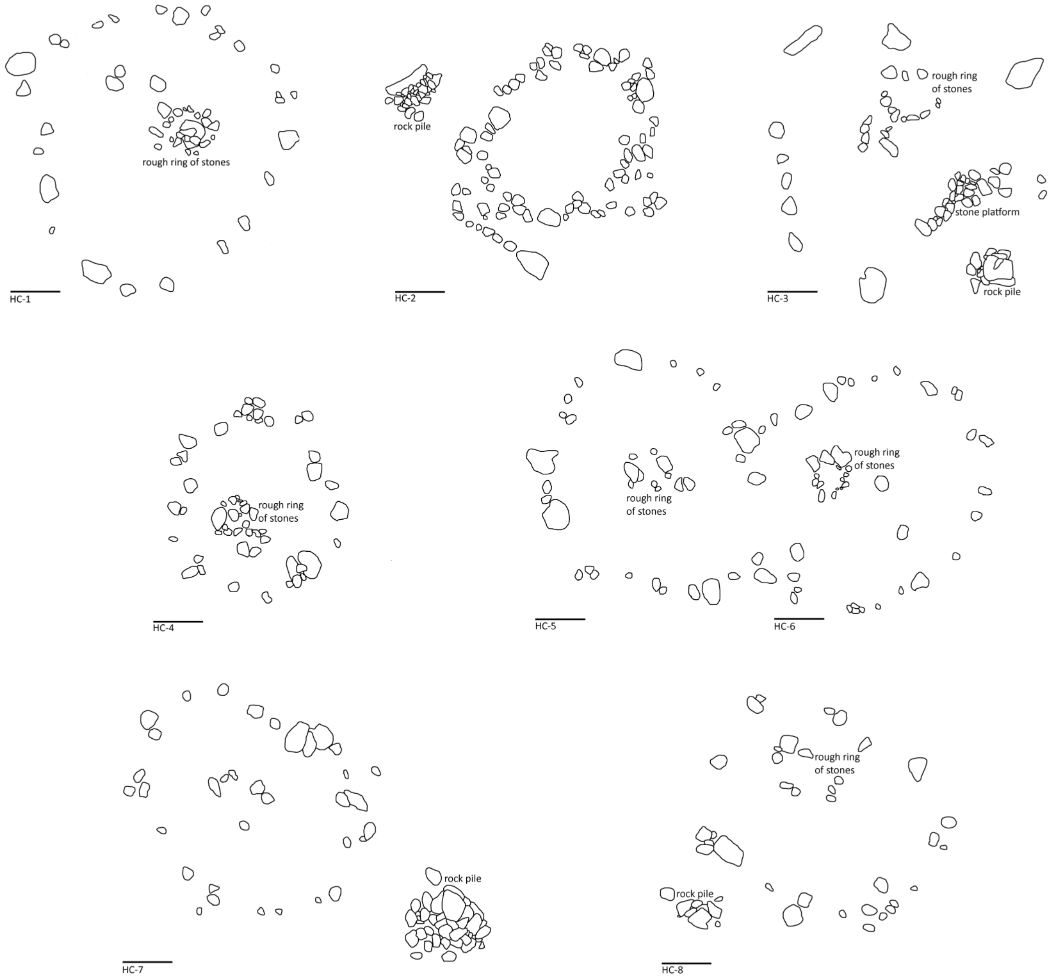


Figure 7.13: Plans of the eight 'hut-circles' with their associated features

As well as the 'hut-circles', six other special/exemplary features were recorded — a representative sample of the surface archaeology encountered during the DSS. A combination of small stone features, rectilinear stone features, curvilinear stone features and stone scatters were recorded (Table 7.8). These features are concentrated in certain locations — four are part of the densest distribution of logged features in the central part of the study area, next to the main watercourse; another is located in another dense area to the north, where three of the hut-circles were also located; while the last is in a low density area in the southwestern part of the site (Figure 7.14).

Feature 1 is a rough, discontinuous ring of 8 sub-angular to sub-rounded wadi cobbles embedded in the ground, with other loose stones resting above the surface (Figure 7.15). It is 1.5x1.4m in size, and is typical of the many 'rough stone rings' that were logged during the DSS. It is located on a wadi terrace that slopes slightly towards a small wadi gully some 10m away, and is a short distance from HC-2 which lies to the north-east.

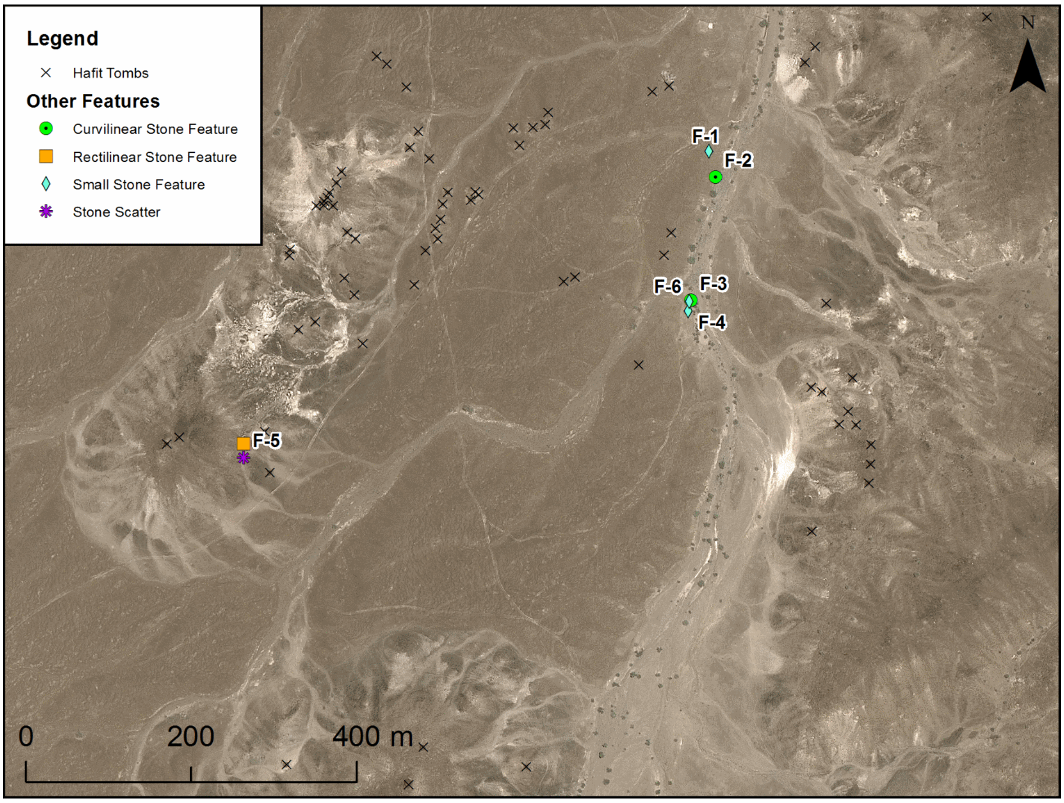


Figure 7.14: Location of the other features recorded in detail

Table 7.8: Characteristics of the six other features recorded

	Dimensions (m)	Class	Description
F-1	1.5x1.4	small stone feature	a rough ring of wadi cobbles
F-2	5.0x4.0	curvilinear stone features	2 irregularly shaped structures of wadi cobbles
F-3	2.4x1.8	curvilinear stone feature	oval structure of wadi cobbles
F-4	2.7 2.0	small stone feature	semi-circular wadi cobble platform with curved tail
F-5	60x30; 3.8x2.2	stone scatter & rectilinear structure	large, oblong wadi cobble platform on the edge of a large scatter of white and brown rock
F-6	6.2x3.7	small stone features	semi-circular line of wadi cobbles with 2 rock piles nearby

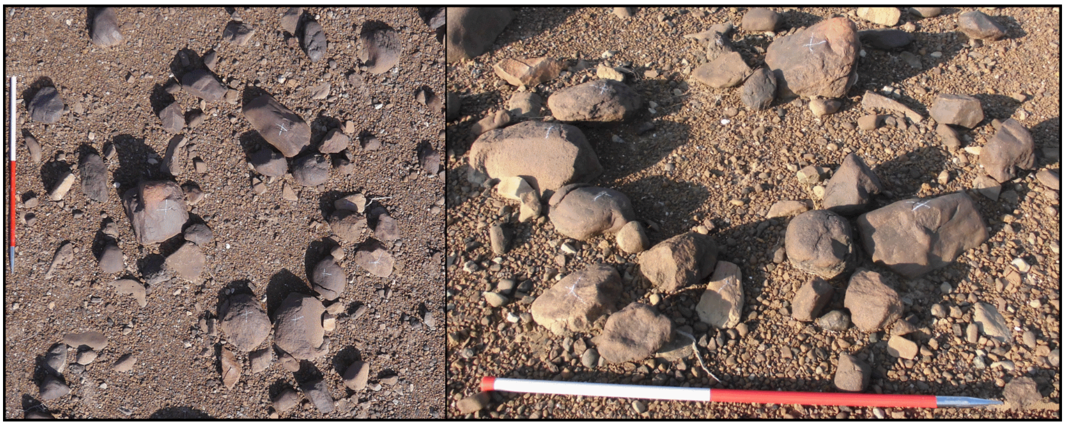


Figure 7.15: Ground and pole camera photos of Feature 1

Feature 2 consists of two sub-rectangular structures of large wadi cobbles (Figure 7.16). The walls survive to several courses high in places, and form structures 3.2x2.2m and 1.45x4m; the latter may originally have been subdivided into two or more chambers. The interiors of the structures contain a loose fill of wadi cobbles, which may originally have fallen from the walls. The two structures are situated on a steep gradient that slopes towards the largest watercourse in the study area, only five metres away.

Figure 7.16: Ground and pole camera photos of Feature 2

Feature 3 is an oval ring of large wadi cobbles (Figure 7.17). The feature is 2.4x1.8m in size, and the walls survive to several courses high. Two very large stones form the western wall and are embedded in the surface pointing upwards. The interior consists of a loose fill of wadi cobbles over gravel, possibly once having formed part of the wall. The feature is orientated ENE-WSW. Feature 3 is located on a slight gradient that slopes towards the major wadi channel 10m away.

Figure 7.17: Ground and pole camera photos of Feature 3

Feature 4 consists of a platform of dense, embedded wadi cobbles (Figure 7.18). The main platform is roughly semi-circular in shape, but it also boasts a 'tail' of further embedded stones that curve around to form part of a sub-circle. The entire feature is 2.65x1.95m. The platform is situated on a wadi terrace that slopes slightly towards the major wadi channel 15m to the east.

Figure 7.18: Ground and pole camera photos of Feature 4

Feature 5 consists of a rectilinear feature at the periphery of a large scatter of white stone flakes and brown/red chert (Figure 7.19). The stone scatter is 'S-shaped'. The thickest central section is located immediately below a ridge forming part of the edges of the 'bowl' of the site and is ~60x30m in size, with thinner protruding parts at both ends running northwest uphill and southeast downhill. At the end of the northwest spur, on a flat area halfway up the ridge is a wadi cobble structure. It consists of two embedded walls — only one course high — of large wadi cobbles, forming a oblong platform 3.8x2.2m in size. The platform is adjacent to an outcrop of faulting bedrock that contains brown chert. The location of Feature 5 provides a good view of much of the natural 'bowl' of the site. Three lithics were collected during the pickup in and around this feature. The scatter consisted of apparently natural flakes of a soft white stone, brown chert and an accompanying brown limestone.

Feature 6 encompasses three neighbouring small stone features — a semi-circular structure of wadi cobbles and two rock piles of larger stones (Figure 7.20). The former consists of a single course of sub-angular to sub-rounded wadi cobbles embedded in the ground surface and forming a semi-circle 1.3x0.9m in size. The loose wadi cobbles inside this feature may suggest that it was originally taller, unless they had some other function. The two rock piles of large cobbles are irregularly shaped and are 1.2x0.9m and 0.9x0.8m in size. The semi-circular feature is less than 1m from one rock pile and approximately 5m from the other. Feature 6 is located on the gentle gradient of a wadi terrace that slopes towards the major wadi located 7m to the east.

No pottery was observed around any of these features. Despite careful pickups, lithics were only found associated with one structure: three lithics were found within a few metres of Feature 5 — two flakes and one large hand tool of red/brown chert.

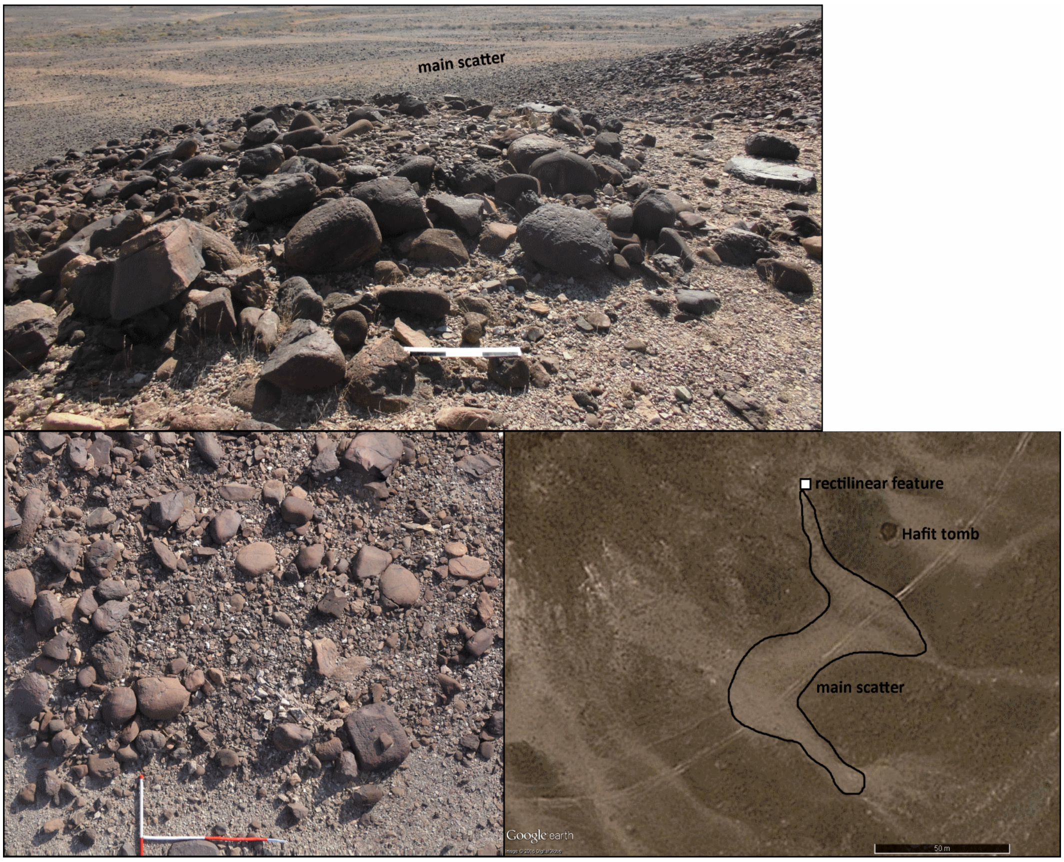


Figure 7.19: Ground and pole camera photos, and annotated satellite imagery of Feature 5

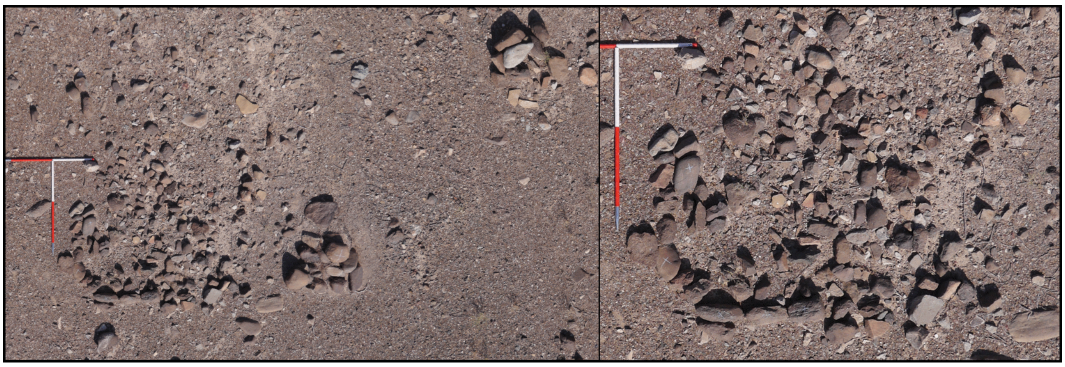


Figure 7.20: Pole camera photos of Feature 6

7.4.3 The ceramic and lithic surface finds

Given the extent of the site surveyed and the time and effort devoted to surface pickups, remarkably few finds were collected during fieldwork at al-Buyraq. The DSS consisted of detailed ‘fieldwalking’ of 30 hectares in 10m transects, while 5–10 minutes was spent painstakingly checking each of the recorded features and the surrounding area for surface finds, yet only a handful of lithics and potsherds were collected.

Only thirteen ceramic sherds were observed at the site in total. Twelve of these came from the same findspot and clearly formed part of the same vessel — a storage jar of Late Islamic red coarseware. One rim sherd was collected (Figure 7.21), and the rest were left in situ.

Figure 7.21: One of twelve Late Islamic coarse redware sherds of the same vessel found during survey

The remaining sherd was found in isolation, not obviously associated with any surface remains, and consists of part of the base of a vessel of well-levigated and fired orange clay, decorated with fine surface incisions and a badly degraded slip (Figure 7.22). The ware, incisions and slip are consistent with a known form of sgraffiato vessel, dating to the Middle Islamic period (12–13th century AD) (Kennet 2004: figure 9).

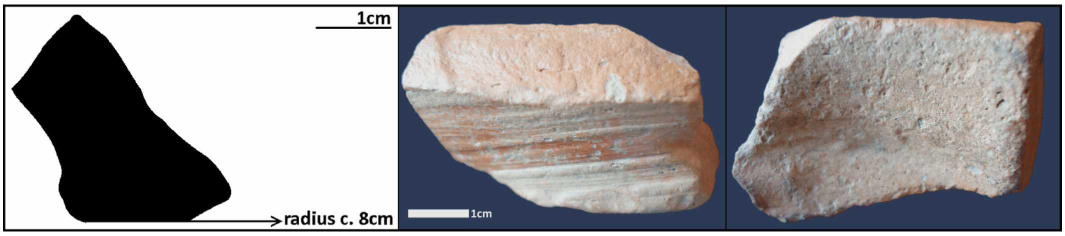


Figure 7.22: A degraded sgraffiato base sherd found during survey, dating to the Middle Islamic period (12–13th century AD)

In total thirteen lithics were collected during the fieldwork, some are clearly of anthropogenic origin and the unnatural removals from others suggest that they are probably anthropogenic (Table 7.9, Figure 7.23).

The material is locally occurring chert, mostly red/brown in colour with a smaller proportion of dark caramel. The quality — i.e. the fineness of the grain — varies, although in general it is relatively coarse (Figure 7.24). It is possible in some cases that the quality only appears low, following long-term abrasion from wind-blown sand while lying on the surface. Most are flakes and cores, but two broken blades and two simple tools were also found (Figure 7.25).

Table 7.9: Details of thirteen lithics recovered during the DSS

Lithic (ID)	Fieldwork	Certainty	Quality	Type	Associated Feature	Notes
1 (FLN-01)	survey	possible	low	blade	rough stone ring	broken blade? some ragged removals, others cleaner
2 (FLN-02)	survey	definite	low	core	none	two small flakes removed unidirectionally
3 (FLN-03)	survey	definite	high	blade	rock pile	very damaged, broken at both ends, flake clearly taken off
4 (FLN-04)	survey	possible	low	core	none	core? appears worked, but fractures not entirely convincing
5 (FLN-05)	survey	definite	low	tool	none	lithic with notch – either retouched or use-wear
6 (FLN-06)	survey	definite	low	flake	none	flake with further material removed, scraper?
7 (FLN-07)	survey	definite	average	flake	rectilinear feature	one flake removed
8 (FLN-08)	feature recording	definite	average	core	hut-circle (HC-3)	removals from three different sides
9 (FLN-09)	chance find	definite	average	flake	none	three previous flake scars on exterior surface
10 (FLN-11)	feature recording	definite	low	core	hut-circle (HC-4)	two striking platforms, two or three removals off each
11 (FLN-12)	feature recording	definite	average	flake	rectilinear feature (F5)	at least two removals from ventral surface, flake or debitage
12 (FLN-13)	feature recording	possible	low	flake	rectilinear feature (F5)	very weathered flake?
13 (FLN-14)	feature recording	definite	average	tool	rectilinear feature (F5)	small chopper, clearly worked to create a working edge

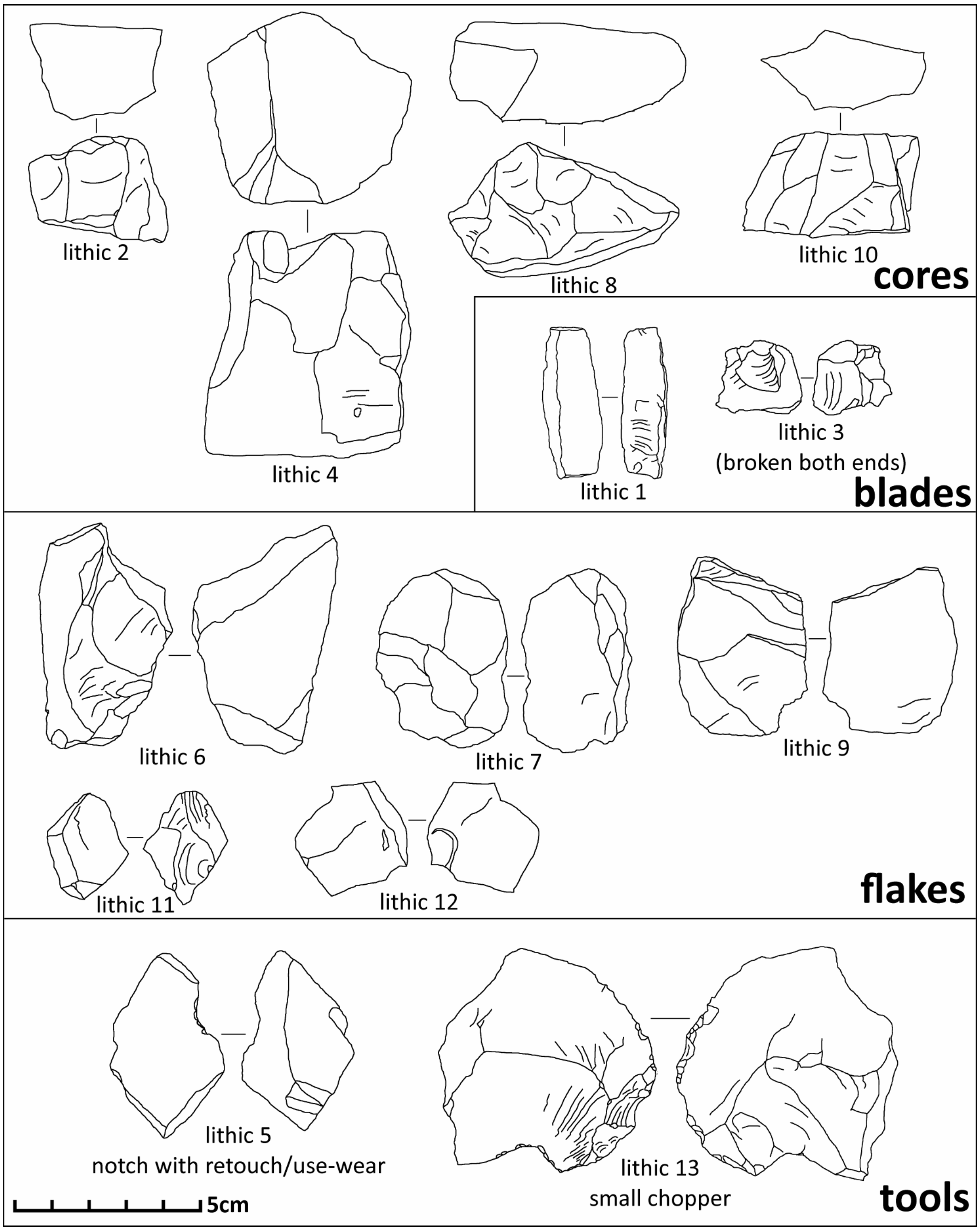


Figure 7.23: The thirteen lithics collected during the DSS by type

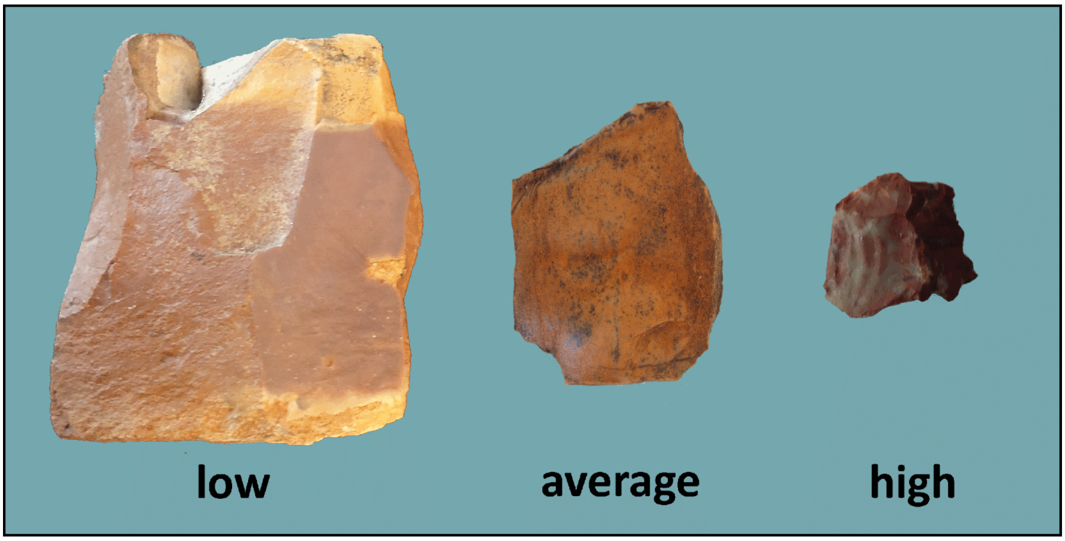


Figure 7.24: Example lithics showing variation in the quality of the chert in the assemblage (not to scale)

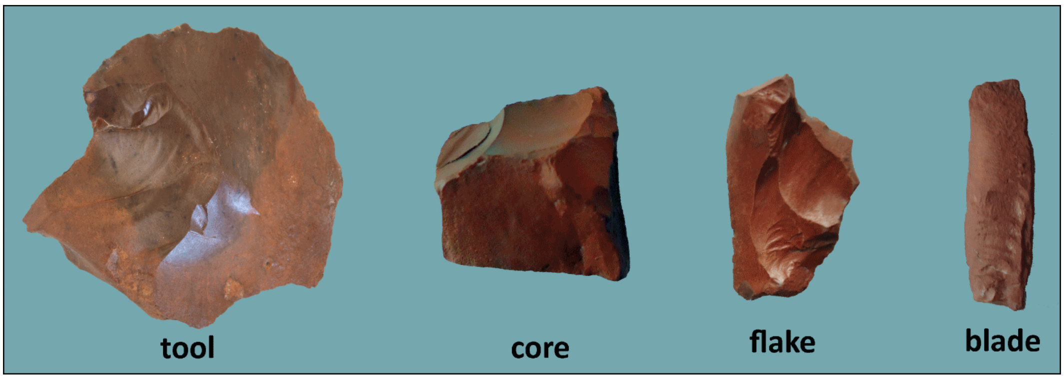


Figure 7.25: Example lithics showing range of forms in the assemblage (not to scale)

7.5 Discussion

The DSS uncovered compelling evidence of past settlement at the Hafit cemetery of al-Buyraq. While not all of the 355 features logged are clearly anthropogenic, many are irrefutably so, testifying to significant use and occupation at the site in antiquity. The features themselves are somewhat ephemeral — mostly consisting of insubstantial arrangements of rocks on the deflated desert pavement — but the likely function of some is apparent. Rough rings of stones were the most numerous features, with almost half clearly resembling simple hearths. Detailed investigation was focused on eight 'hut-circles' — the most promising, clear and direct evidence for settlement. The term is perhaps aggrandising of these rough circles of wadi cobbles and boulders. It is unlikely that the hut-circles formed foundations for a substantial superstructure of wood or mudbrick, but are more likely to have anchored tents or shelters of animal skin or light-weight plant material — 'tent rings' may be a more accurate description. The fact that smaller rough rings of stones — possible hearths — were frequently found inside or just outside these features is encouraging. 'Hut-circles' were also often associated with rock piles — another of the most common features logged during the survey — either incorporated within the circle of stones or situated just outside. These may have acted as anchoring points for skins or guide-ropes, or supported more substantial parts of the superstructure. Although frequently less compelling features than the hut-circles, rough semi-circles of stones are more common, making up the majority of the curvilinear features logged during the survey. These are smaller than the hut-circles — a diameter of 2–3m rather than 4–6m — and may have supported smaller, semi-circular shelters. It is pointless to speculate on the function of many of the features logged during the survey; although clearly anthropogenic, the surface archaeology is too little to go on — for example the short wall sections and small stone platforms. However, there is a clear case to be made for some significant human occupation of the site.

The distribution of the features across the site is not uniform. The density varies with much of the site boasting fewer than 7 features/hectare, while less than a tenth by area has 17 or more. The high density areas are concentrated along the wadi banks, especially the largest channel and its most sizeable tributary — clustered near potential water supplies. At a broader level, features are not congregated in discrete patches surrounded by large areas of absence — rather, they are fairly ubiquitous across the site. Their distribution does not suggest a single, static 'settlement', but rather a large area used repeatedly but on a small scale over a prolonged period of time with certain parts of the site favoured over others.

The ubiquitous if somewhat patchy distribution and the insubstantial nature of the features suggest a temporary occupation of the site rather than a permanent settlement. Al-Buyraq appears to have been repeatedly used as a camping ground over a prolonged period of time, at a relatively small scale and with shelters of mainly portable, light-weight organic materials. This is most consistent with the occupation of the site by a nomadic population.

While the occupation of al-Buyraq appears to have been limited to a series of temporary and low-impact camps, dating this activity is problematic. Ostensibly, there is very little dating evidence to go on: a tiny assemblage of lithics and ceramics. All but one of the thirteen sherds collected originate from the same Late Islamic vessel; a single broken vessel is not enough to date the settlement remains at the site, especially since Late Islamic sites ordinarily yield vast quantities of pottery (e.g. Kennet, al-Jahwari, Deadman, and Mortimer 2014: 41–48). The other sherd dates from the Middle Islamic period (12–13th century AD), ceramics from this period are much less common in the area (Kennet, al-Jahwari, Deadman, and Mortimer 2014: 41–48; Kennet, al-Jahwari, Deadman, Mortimer, et al. 2015: 99–100; Kennet, al-Jahwari, Deadman, Brown, et al. 2016: 144), but nonetheless a single highly-degraded sherd cannot plausibly be used to date the site's widespread settlement evidence. The lithic assemblage is made up of nondiagnostic pieces, and could date from any period including the Early Bronze Age (Charpentier, pers. comm.). However, while the surface finds themselves are of little help in concretely dating the site, more detailed analysis should limit the possibilities.

Al-Buyraq is essentially aceramic — an assemblage of thirteen sherds from two locations is negligible considering the 30 hectare area of the site, and the presence of hundreds of surface features. The plausible dating of an aceramic settlement is limited. Pottery is widespread at Islamic, Iron Age, and Umm an-Nar settlements; while though largely absent in this part of the Oman Peninsula, further north Wadi Suq and Late Bronze Age settlements are readily identifiable from their distinctive ceramic assemblages (Velde 2003). Therefore, there is a high likelihood that al-Buyraq dates to a point before the introduction and widespread use of pottery in the Oman Peninsula — i.e. either during or prior to the Hafit period. However, it should be stressed that a lack of pottery does not prove such a date — sites ascribable to later periods through other evidence can also fail to produce a diagnostic ceramic assemblage. While the small, low quality and nondiagnostic lithic assemblage is of little use for pinpointing the date of the site, these ordinarily undesirable characteristics provide indirect insight. Given the meticulousness of the survey, the site's large area, and the sheer number and density of the surface features present, a larger lithic assemblage would be expected if it dated to the 4th millennium BC or before. Moreover, the different lithic industries and assemblages from the Holocene to the 4th millennium BC are relatively well understood and are often of considerable quality (e.g. Charpentier 2008), making a Stone Age date for the site unlikely given the poor quality of the lithics at al-Buyraq. The assemblage is consistent with what would be expected from a Bronze Age assemblage, when copper became the primary material for tools, but stone also continued to be used — i.e. small, simple and unsophisticated (Choimet 2016; Bandar Jissa facies in Uerpmann 1992b). This would be particularly true given the fact that the site is so close to copper ore sources. Relatively little is known about the lithic industry of the Early Bronze Age, but analysis of an assemblage from HD-6 characterised the material as an "ad hoc industry, with a series of expedient productions, lacking formal specialisation" (Hilbert and Azzara 2012: 17). Similarly, an Early Bronze Age assemblage from Bat is poorly retouched, not part of a regular knapping pattern, lacks reoccurring tool forms, uses relatively low quality material, and is described as "somewhat haphazard" (Choimet 2016: 228). Al-Buyraq lithic assemblage is not irrefutably diagnostic of the Early Bronze Age, but the assemblage is consistent with what would be expected from a site of such date. Although circumstantial — dating by association is always conjectural — the presence of such a large number of Hafit tombs provides evidence for the contemporaneity of the insubstantial settlement remains. There are more than one hundred Hafit tombs within a kilometre of the site, and over sixty on the hills that make up the edges of the 'bowl' that surrounds the site to the east, south and west. This demonstrates a significant Hafit presence in the area, and given the deflated nature of the area their non-funerary activity within the landscape should be visible. The distribution of the settlement archaeology provides further circumstantial dating evidence: it is densest near the wadis, which drain an area of only a few square kilometres. If the concentration of occupation remains relate to water availability, than it most likely dates to a period of higher rainfall, pre-dating the aridification of the climate during the Umm an-Nar period (Parker and Goudie 2008: 468). No evidence is available to date the ephemeral occupation remains at al-Buyraq unequivocally; however, the virtually aceramic nature of the site, the presence of low numbers of low quality lithics, the significant number of Hafit tombs, and the preference of the features for areas in close proximity to the small wadi channels are consistent with a Hafit date.

The archaeological remains discovered during the DSS at al-Buyraq are consistent with what would be expected of a Hafit settlement in the Batinah, and are also consistent with an Early Bronze Age date. The insubstantial collection of possible hearths, hut-circles, small open shelters, and other more enigmatic features, as well as a lack of pottery and a small assemblage of low-quality and nondiagnostic lithics, are accordant with the picture of small bands of nomadic Hafit pastoralists moving around the Batinah landscape.

7.6 Conclusion

The aim of this chapter was to locate and analyse Hafit settlement remains in order to add greater detail to, and to test, the analysis of the funerary archaeology of the Batinah. During the DSS hundreds of insubstantial features were observed, including possible hearths, hut-circles, and other anthropogenic stone arrangements, as well as a small assemblage of lithic artefacts. These remains are consistent with what would be expected of a Hafit settlement, although absolute dating of the site was not possible.

The discovery of a possible Hafit settlement is a major achievement; only a very small number are known, and they are extremely difficult to date with certainty (Chapter 1.1.1). To the present author's knowledge, this is first attempt that has been made specifically to locate settlement remains based on the distribution of Hafit tombs. The discovery of such a wealth of material demonstrates the success of the methodology which could be readily used in other sites in all parts of the northern Oman Peninsula.

Within the context of the thesis as a whole, this research complements the analyses of the Hafit funerary record. Although the settlement remains at al-Buyraq cannot be associated unequivocally with the Hafit tombs at the site, they provide circumstantial evidence that adds further detail to the picture of Hafit society in the Batinah. In the following part of the thesis, the entire body of research already presented will be considered together within its wider context of the Early Bronze Age of the northern Oman Peninsula, and more broadly within the fourth and third millennia BC in the Near and Middle East.

Part III

Discussion & Conclusion

Chapter 8

The nature of Hafit society in the northern Oman Peninsula and Al-Batinah

The aim of this thesis is to explore Hafit economic and socio-political organisation and structures in the northern Oman Peninsula, particularly in the Batinah region. The following chapter will bring together data and analysis from previous chapters and the wider literature to provide fresh insight into the nature of Hafit society.

Notwithstanding fifty years of archaeological research investigating Hafit tombs, the extent and depth of our current understanding of Hafit society is lamentable. Remarkably little has been published on the subject, and much of what has been written is speculative. Published opinion and current theories have already been reviewed in detail (Chapter 2), demonstrating that basic questions as to Hafit subsistence, economy, politics, and ideology remain as yet unanswered. The origins of the Hafit population itself are still not firmly resolved, with some suggesting the immigration of one or more foreign communities into the region. There is disagreement as to the primary mode of Hafit subsistence, with sedentary arable agriculture, nomadic pastoralism and semi-nomadic agro-pastoralism all mooted, and the possible role of seasonal migration unclear. Two contradictory models as to the development of Hafit society remain current: the wholesale adoption of agricultural and other technologies at the start of period, and a more gradual change with the major developments taking place in a transition phase prior to the Umm an-Nar period. Although much has been written about copper mining and international trade, there is very little direct evidence for metallurgy during the Hafit period. Similarly, the idea of the division of the landscape into Hafit territories is commonplace, but with little detail as to the nature of such political units. While there is general agreement as to the egalitarian nature of Hafit society, debate remains as to exactly how power and wealth were distributed. Speculative models of kinship as the primary organisational factor in Hafit society as yet lack substantive support. Hafit ideology and belief systems have received relatively little attention.

In an attempt to shed new light on Hafit society, across the northern Oman Peninsula as a whole and specifically in the Batinah region, the following sections will draw together evidence presented in previous chapters and the wider literature. Firstly, the evidence for Hafit subsistence will be explored, examining the role of nomadic pastoralism and sedentary agriculture, investigating the significance of marine resources, discussing the evidence for seasonal migration and considering the process of sedentarisation towards the latter part of the period. Next, aspects of the wider Hafit economy will be examined, exploring the role of copper, local exchange, and international trade in society, and discussing the emergence of specialisation and the development of new skills in the Hafit population. Finally, Hafit politics and ideology will be considered, exploring the political division of the northern Oman Peninsula, expressions of Hafit territoriality, and the likely social organisation of the Hafit population, as well as analysing the meagre evidence for Hafit ideology, and discussing social and political change over the course of the period. While the imperfect reliability of the Google Earth-based methods utilised in some chapters means that conclusions drawn from such evidence should be tempered with due caution (Chapter 4.2), nonetheless this chapter should contribute substantially to the discussion of Early Bronze Age society in eastern Arabia.

8.1 Subsistence

Firstly, the evidence for subsistence will be explored, in an attempt to establish the primary strategy of Hafit food production. The case for a primarily nomadic pastoralist Hafit population in the northern Oman Peninsula will be set out, and the unique aspects of nomadism in the Batinah will be discussed. Next the evidence for Hafit nomadic settlement remains, coastal exploitation, seasonality, and changes in subsistence towards the end of the period will be examined.

8.1.1 Nomadic pastoralism

Since Cribb's ground-breaking work (1991) there has been a surge in interest in the archaeological investigation of nomadic pastoralism (e.g. Kardulias 2015; Szuchman 2008; Barnard and Wendrich 2008; Kradin et al. 2003). The term broadly refers to any socio-economic strategy based around the migratory management of herd animals (cf. Frachetti 2008: 15). Generalised characterisations of the different lifestyles that fall under this umbrella concept have emerged (e.g. Khazanov 1984), most commonly: nomadic pastoralism denotes a strategy in which the entire group moves with their animals; semi-nomadic pastoralism suggests that part of the population is settled or that the entire population is settled for part of the year; agropastoralism combines agricultural and pastoralist activities; while transhumance denotes some seasonal aspect to a group's movements determined by the weather or resources prevalent in different areas for part of the year (Wendrich and Barnard 2008: 7–8). Although still widely used in the current literature, there is significant disquiet with the rigidity and reductiveness of such typologies and a contemporary focus on the variability and flexibility of mobile pastoral societies (Frachetti 2008: 16–17). The long-held view of nomadic pastoralists as inferior, marginalised groups peripheral to and dependant on sedentary agricultural communities is also being challenged (Honeychurch 2014: 279; Wendrich and Barnard 2008: 10). In the past it has been assumed that nomadic pastoralism emerged from mixed sedentary communities as an alternative subsistence strategy suited to marginal environments (e.g. Lees and Bates 1974), but more recent thought suggests that this cannot have been the case in at least some regions and that there are likely to have been multiple pathways to such a strategy (cf. Honeychurch and Makarewicz 2016: 343–344). In the southern Levant domesticated caprids were first exploited intensively during the Late PPNB (late 8th, early 7th millennia BC), but nomadic pastoralism is thought to have emerged in the Early Bronze Age or Chalcolithic, or possibly earlier in the late 7th or early 6th millennia BC as part of a mixed strategy that included hunting and, possibly, opportunistic agriculture (Makarewicz 2013: 161–162; Rollefson et al. 2014).

A strong relationship between nomadic pastoralism and the construction of monumental collective tombs is attested in a wide variety of archaeological contexts (e.g. Honeychurch, Wright, et al. 2009; Cardoso 2008; Rosen et al. 2007; Di Lernia and Manzi 2002; Stiles and Munro-Hay 1981). There is diverse discussion of possible explanations for the construction of monumental architecture in past societies: the control of access to crucial limited resources (Saxe 1970; Renfrew 1973; Chapman 1981); the reinforcement of the political control or profile of an elite (Earle 1997; Trigger 1990; Cherry 1978), and/or a means by which such a group emerges (Richards 2004; Bradley 2001; Barrett 1994); engendering memory in a community (Thomas 2006); embodying and anchoring ancestral connections to the landscape (Tilley 1994); the imposition of order on the world (Barrett and Ko 2009); and as cultural rhetoric in converting populations to a new way of life (Sherrat 1995). Similarly the application, and interpretation, of collective burial can reveal much about the nature of past societies: for example, it can act as a means of reinforcing the significance of the group over that of the individual, and of excluding others from it (Renfrew 1974; Watson 1994; Chapman 2007; 1990; Chesson 2001); it can reinforce existing power structures through association with the select members that were interred, or legitimise the social order through a show of solidarity in the group while denying asymmetrical relationships (Fleming 1973; Shanks and Tilley 1982); and it can be a means of commemorating the dead and thereby forging or renegotiating group identities and relationships (Porter 2002; Chesson 2007). There is diverse opinion as to the role of monumental collective tombs in nomadic pastoralist societies. There is debate among archaeologists working in Mongolia as to whether the construction of monumental collective tombs and mortuary monuments testify to a newly emerged Bronze Age elite or a heterarchy of early pastoralists seeking to build a stable social landscape (Houle 2010; 2009; Allard and Erdenebaatar 2005; Wright 2012); although there is a general consensus that later on the re-use and construction of new monuments did contribute to the emergence and perpetuation of hereditary leadership (Honeychurch, Wright, et al. 2009). In the Negev it has been argued that the construction of monumental collective tombs, amongst what is interpreted as the remains of a Late Neolithic mortuary cultic site, is directly linked to the introduction of mobile pastoralism as a subsistence strategy into the region (Rosen et al. 2007). Similar assertions have been made for burial cairns in the desert of southeast Jordan, that these tombs served a need to establish territorial rights to grazing and water, and provided meaningful focal points in the landscape in the context of the newly adopted nomadic pastoralist way of life (Abu-Azizeh et al. 2014). In the third millennium BC in Syria it has been suggested that the construction of monumental collective tombs contributed significantly to the sedentarisation and the social stratification of a nomadic pastoralist community, but that the continued use of the funerary structures worked to resolve the tension between a new elite and the traditions of a once communally-based society (Porter 2002). Much of this research is highly relevant to Early Bronze Age society in eastern Arabia.

Arabia was occupied by large numbers of nomadic pastoralists by the 6th millennium BC (Magee 2014: 47). It is generally accepted that both the domesticated animals and contemporary lithic technology were imported, either through trade or human migration (Boivin and Fuller 2009: 132–133), from the southern Levant — wild goats, sheep and cattle are not native to Arabia and stone tool assemblages show similarities to those of this neighbouring region (Drechsler 2007; Crassard, Petraglia, et al. 2013). Faunal remains from Arabian sites suggest the existence of a mixed subsistence strategy combining herding, hunting and — at coastal sites — fishing from the sixth to the fourth millennia BC (Martin et al. 2009; Uerpmann et al. 2000; Beech, Cuttler, et al. 2005; Biagi and Nisbet 1999). The balance of these components within the economy is likely to have varied depending on the local conditions, and it is possible that ‘dedicated pastoralism’, a reliance on herds for subsistence, developed in situ in certain parts of the region (McCorriston 2013). The earliest evidence for arable agriculture in Arabia comes from the south (Charbonnier 2008). In the highlands of western Yemen terraced field walls and run-off irrigation devices have been radiocarbon dated to the early fourth millennium BC (Wilkinson 1999: 188). Similar evidence for simple run-off irrigation probably dates from the second half of the fourth millennium BC in Hadramawt and likely testifies to a subsistence strategy of transhumant agropastoralism (Harrower 2008).

8.1.2 Hafit nomadic pastoralism or sedentary agriculture?

Data and analysis presented in previous chapters has much to add to the debate as to whether nomadic pastoralism or sedentary agriculture was pre-eminent during the Hafit period. The results of the northern Oman Peninsula Google Earth (NOP-GE) survey demonstrate that Hafit tombs favour certain topographical areas (Chapter 4.3.3). The major areas of absence/very low density are the Hajar Mountain uplands; the Musandam; the plains of the Batinah; central Dhahirah and Dakhiliyah; western Sharqiyah; and the desert fringe of the Wahiba Sands and the Rub' al-Khali (see Figure 4.51). Tombs are very rarely located on the coast, other than in Ja'alan in eastern Sharqiyah. They are concentrated in foothills on both the southwestern and the northeastern sides of the Hajar Mountains. In many cases tomb agglomerations overlap with wadi basins, with the densest concentrations running along major wadi channels, although this pattern is not apparent in the Batinah. GIS analysis of the NOP-GE survey results confirmed the existence of a strong relationship between Hafit tomb numbers/ubiqity and hydrology (Chapter 4.5.2). A combination of topography and hydrology appears to have dictated the location of Hafit occupation areas — in the foothills large volumes of run-off from the uplands collect in wadis, but this surface flow has yet to sink into the gravels of the alluvial plains. Wadis also facilitate access to the seasonal water and grazing that follows winter rains in elevated areas, and to the deep-rooted plants and groundwater in the gravels nearer the plains when surface flows dwindle in the summer. This Hafit preference for the low foothills is most consistent with a nomadic pastoralist population that moved their herds to different parts of the wadi systems depending on what water and grazing was available. This can be demonstrated by contrasting it with traditional agricultural settlements of more recent times, which, based on sedentary farming, exhibit a very different distribution — they are concentrated in the more elevated areas of the foothills, in the mountain uplands, and on the coast (Figure 8.1). These villages source water to irrigate palm gardens: on the coast wells are used to exploit the fresh-water table; in the mountains water is sourced from springs; and in the more elevated foothills *falaj* are used to either divert groundwater from wadi gravels upstream or to tap mountain aquifers (Wilkinson 1977: 47–48, 74–76; Luedeling and Buerkert 2008: 1193). Naturally, the distribution of traditional/modern settlements reflect the areas in which groundwater may be sourced and controlled, the fact that the Hafit tomb distribution does not overlap with these areas may suggest that the Hafit population did not share the same reliance on groundwater and may therefore have exploited wadi surface flow and seasonal water sources. This is more consistent with independent nomadic pastoralism, in which herders and animals follow water and grazing where it is available, than sedentary agriculture which requires a static and perennial water supply.

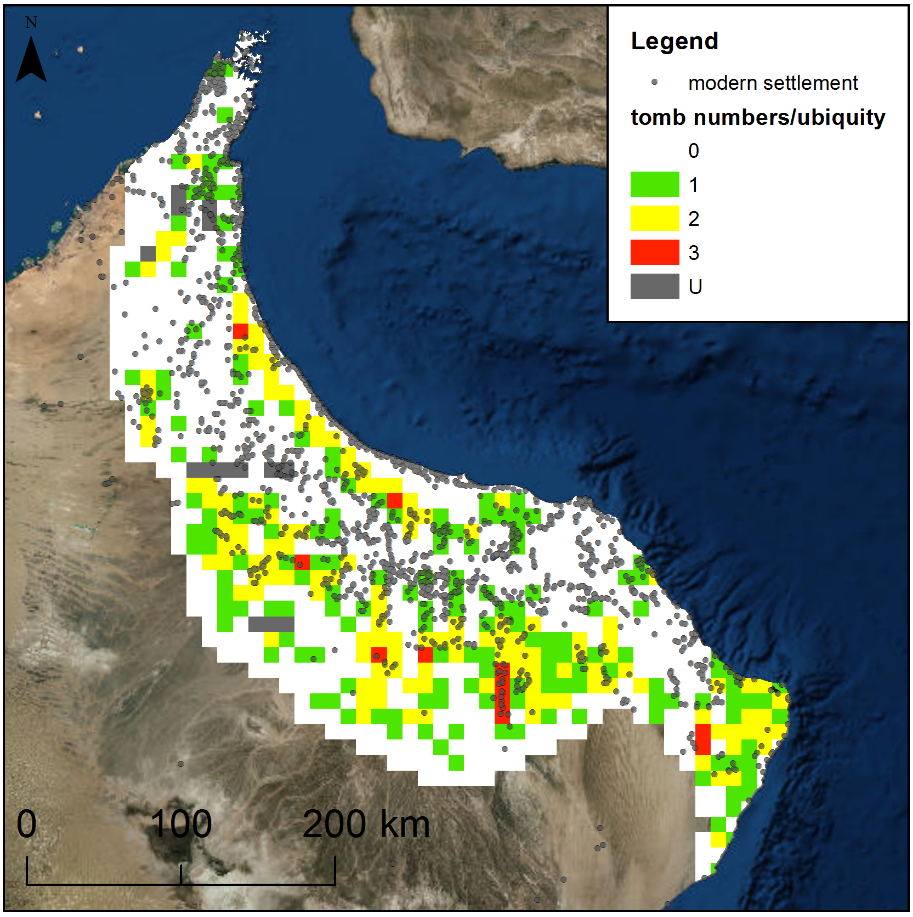


Figure 8.1: NOP-GE survey results and the distribution of modern settlements

Population levels can contribute to our understanding of subsistence strategy. As part of the NOP-GE survey, the total number of surviving Hafit tombs and the size of the living population was estimated at just over 50,000 tombs and between eleven and twenty-nine thousand people (Chapter 4.4.2). Although the inaccuracies involved in the estimation process mean this figure is really only an informed guess, it is the best estimate that is currently available and is nonetheless useful for better understanding Hafit society. The NOP-GE survey area covers over 81,000 sq-km, and based on these figures supported only 0.14–0.35 people/sq-km. If grid squares with no Hafit tombs are excluded — many of which are located in the mountain uplands and the southern desert plains — the area is reduced to almost 31,000 sq-km and population density increases to

0.35–0.92 people/sq-km. Wilkinson calculated that over a similar area, well before the modernisation of the Omani and Emirati economies, the population numbered between 500,000 and 600,000 at between 2.2 and 2.5 people/sq-km (1977: table 1). This suggests that Hafit subsistence strategies supported only a fraction of the population that traditional agriculture, pastoralism and fishing did in the early 20th century. Ethnographic examples demonstrate that population density is a function of subsistence strategy and the local environment: hunter-gatherer-fisher population densities vary from 0.03 to 0.6 people/sq-km; pastoral nomads between 0.06 (desert) to 2 people/sq-km (steppe); primitive farmers from 4 to 20 people/sq-km; and fully developed farmers up to 400 people/sq-km (Cavalli-Sforza and Bodmer 1999: 431–432). The Hafit population density estimate is most consistent with a nomadic pastoralist population inhabiting a challenging environment — if Hafit society relied entirely or even largely on arable farming one would expect a larger population. This must have changed at some point during the third millennium BC as arable farming was certainly practised during the Umm an-Nar period (al-Jahwari 2009), but for much of the Hafit the evidence seems to suggest some form of independent pastoralism that did not rely on agriculture or a relationship with nearby agricultural communities.

The literature is divided regarding Hafit subsistence. Two studies of tomb distribution in Wadi ‘Andam, a major concentration of Hafit tombs, independently concluded that the area had been inhabited by a nomadic or semi-nomadic Hafit population (al-Jahwari 2013b; 2008; Deadman 2012a). The present author argued that the distribution of the Hafit tombs, their spatial relationship with wadi channels rather than modern cultivated land, and their high visibility pointed to a nomadic pastoralist population (Deadman 2012a: 32–33). Al-Jahwari asserted that the lack of compelling settlement evidence associated with Hafit tombs in his multi-period survey suggested that the Hafit population was made up of nomadic pastoralists that used Wadi ‘Andam as grazing land; he interpreted insubstantial stone platforms as the remains of possible Hafit perishable shelters (2013b: 59). Further survey in western Ja’alan, another dense concentration of Hafit tombs, led al-Jahwari to conclude that the Hafit population in this area was also made up of nomadic pastoralists (2013a: 163). As in Wadi ‘Andam, it was not possible to find Hafit settlements in western Ja’alan despite meticulous ground-based survey that located only ephemeral surface remains. In addition, Hafit tombs demonstrated a clear relationship with wadis rather than areas of modern arable land (al-Jahwari 2013a: 163–169). A lack of agricultural remains at the Hafit copper smelting site of al-Khashbah led the team investigating the site to conclude that despite its substantial stone architecture, the site was occupied only occasionally by a nomadic population (Schmidt and Döpper 2017: 224–225). Three seasons of survey and excavation at several Hafit cemeteries around Dhank, have led the SoBO team to conclude that the Hafit population in this area was made up of nomadic or semi-nomadic pastoralists that settled as agropastoralists by the Umm an-Nar period (Williams and Gregoricka 2013: 135, 146). Palaeopathological study of Hafit human remains is very limited, and largely consists of dental analysis due to selective preservation. A similar dental health profile has been observed at the vast majority of sites: moderate to severe wear; few or no caries; and some ante-mortem tooth loss (Benton and Potts 1994: 61, 65, 67; Littleton and Frohlich 1993: table 8; Munoz 2011: 221–224; Williams and Gregoricka 2013: 141–148). This is consistent with a mixed subsistence economy and a diet lacking in fermentable carbohydrates, and is similar to that recorded for modern Bedouin pastoralists (Littleton and Frohlich 1993: 444–445). This dental profile contrasts with that seen later when dates formed a significant part of the diet of sedentary farmers: a high incidence of caries; low wear; and accelerated tooth loss (e.g. Yule, Nelson, et al. 1999). This pattern was observed in teeth recovered from two Hafit tombs at Jabal Hafit (Højgaard 1985: 151), but reuse of the tombs in later periods was frequently observed at the site and the excavations are yet to be fully published (Frifelt 1971). Overall, Hafit dental remains appear to be much more consistent with a mixed, pastoralist subsistence strategy, than sedentary palm oasian farming.

Overall, the evidence for arable farming in the Hafit period is very slight. Currently, only Hili 8 provides any evidence for the transition from pastoralism to sedentary agriculture (Magee 2014: 94). The parts of the site that are thought to be Hafit include: a mudbrick fortified round-tower with ditches and other buildings; beads; copper objects; ceramics; caprid, bovid, equid and camel bones; and palaeoenvironmental remains including dates, wheat, barley, oats, and fruit (Cleuziou 1989a). This phase was dated to the end of the fourth or the beginning of the third millennium BC through two charcoal samples from a hearth beneath the round-tower (Cleuziou 1979: 32, table 1). However, concerns have been raised about this anomalous date (Potts 1997: 66–67), as the site's ceramic assemblage is more consistent with the early Umm an-Nar period, and it has recently emerged that Umm an-Nar tomb facing stones have been recovered from domestic architecture at the site (Chapter 1.1.1). Date stones have been recovered from two suspected Hafit settlements in Ja'alan (Azzara 2009: 6; Blin 2007: 250), but the date of these sites is unproven. Giraud's analysis of Hafit tomb distribution in Ja'alan revealed that "most of the necropoleis are found in areas where oasis agriculture is possible" (Giraud and Cleuziou 2009: 176), but this of course does not prove that farming actually took place. It is not unlikely that, as in broadly comparable neighbouring areas during this period (Harrower 2008), some form of very simple cultivation did take place during the Hafit period, but that this along with hunting and foraging, supplemented the primary nomadic pastoralist means of subsistence that did not rely on non-existent, nearby agricultural communities — the somewhat out-dated view of pastoralist economies (Honeychurch and Makarewicz 2016: 343–345).

8.1.3 Nomadic pastoralism in the Batinah

Shifting the focus to the Batinah, remote sensing and fieldwork presented in earlier chapters also point to a nomadic pastoralist Hafit population, albeit following a specific form suitable to the particular geography of the region. The results of the Batinah Google Earth (B-GE) survey demonstrate that Hafit tombs are overwhelmingly concentrated in the low bajada hills of the main outwash plain (Chapter 5.3.3). The tombs form a 'Batinah band' that runs across the bajada's low hills, parallel to the line of the coast and the mountains, while only small numbers are observed in the uplands of the Hajar Mountains or in the lower wadis of the rocky foothills which have been the main focus of settlement since the later Bronze Age (Kennet, Deadman, et al. 2016). This distribution is unlike any known elsewhere in the northern Oman Peninsula. For most parts of Oman — as the results of the NOP-GE survey demonstrate (Chapter 4.6) — Hafit tombs are generally found across a wide area from mountain uplands to the edge of alluvial plains. This Batinah Hafit tomb distribution contrasts markedly with that of recent settlements — modern agricultural villages are concentrated in a dense band on the coast, where soil and water are plentiful, or in smaller numbers along the wadis in the lower mountain uplands and rocky foothills where water and silt can be trapped and redirected and where a variety of irrigation techniques is employable (cf. Costa and Wilkinson 1987). There are very few recent settlements in the bajada zone as it is largely unsuitable for arable farming due to the lack of suitable soil; the strong Hafit presence in this area may suggest that arable agriculture was not a primary feature of subsistence in the Batinah during this period.

GIS analysis revealed a very strong relationship between Batinah Hafit tombs and a discontinuous ridge of Tertiary rock that runs through the Batinah bajada (Chapter 5.4.3). A fifth of Hafit tombs on the Batinah are located within 500m of part of the long, linear outcrop of this material — an area that makes up only just over 1% of the landscape as a whole, whilst more than half are located within 3km — an area that covers 7% of the Batinah. The most likely explanation is that this rock forms an aquiclude — a natural, semi-subterranean dam that forces groundwater closer to the surface behind it. A modern study shows that throughout the Batinah outwash water is closest to the surface behind these larger Tertiary outcrops (Lakey et al. 1995). Higher rainfall, such as that which may have pertained in the Hafit period (see Introduction, Parker, Davies, et al. 2006), may have caused water to pool on the surface for all or part of the year (Anderson

1984: 9, figure 2). Even in the current climate, the wadis of the Batinah channel a huge volume of water — the majority of modern recharge dams in Oman are located in the Batinah and these nine dams together can store almost 50 million cubic metres of water (Shahin 2007: appendix II, table 36). The Tertiary aquiclude, functioning, in effect, as a natural recharge dam, would have created areas that were extremely attractive to Hafit pastoralists. This geological feature and the related Hafit tomb distribution is unique to the Batinah. Interestingly, the Tertiary ridge outcrops are absent in the two northernmost *wilayat* of the Batinah, and here Hafit tomb distribution is more similar to that seen in other regions. Hafit tombs are found in lower numbers in this northern area, and tend to hug the courses of larger wadis for longer stretches than in the central and southern Batinah — underlining, further, the significance of the aquiclude to the Hafit population. A relationship is still apparent between Hafit tomb distribution and wadi channels where Tertiary outcrops are present, but almost always behind the line of the ridge and less tightly than in the two northernmost wilayat.

Although they make up only a small and incomplete archaeological dataset, Batinah Umm an-Nar sites are located in different areas to Hafit tombs (Chapter 5.4.3). They show a distribution similar to modern/traditional settlements — they are located in the lower mountain uplands, the rocky foothills and, possibly, along the coastal strip; they are absent from the bajada (Figure 8.2). A number of these sites are substantial settlements with round-towers — including Dahwa; al-Tikhah; Falaj ash-Shrah; and Yiqa (al-Jahwari, pers. comm.; Kennet, al-Jahwari, Deadman, Brown, et al. 2016: 11; Kennet, al-Jahwari, Deadman, and Mortimer 2014: 26–30). This suggests that as the Early Bronze Age progressed the population moved from grazing grounds around the aquiclude to areas which are also preferred for traditional agricultural settlement — this is consistent with a concomitant shift from nomadic pastoralism to sedentary arable farming.

The spatial arrangement of the Batinah Hafit tombs and cemeteries could also be argued to be consistent with a highly mobile population (Chapter 5.4.3). Across short, medium and long distances, Hafit tombs demonstrate a scattered but continuous distribution. Tombs are few and distant from each other: within a 100m radius Hafit tombs have only 3.2 neighbours on average, while at 1km this rises to 65.7, and at 4km to 326.0 (Figure 8.3). This type of cemetery structure marries with the movements of a nomadic population around their territory, interring their dead on the nearest suitable high ground as necessary.

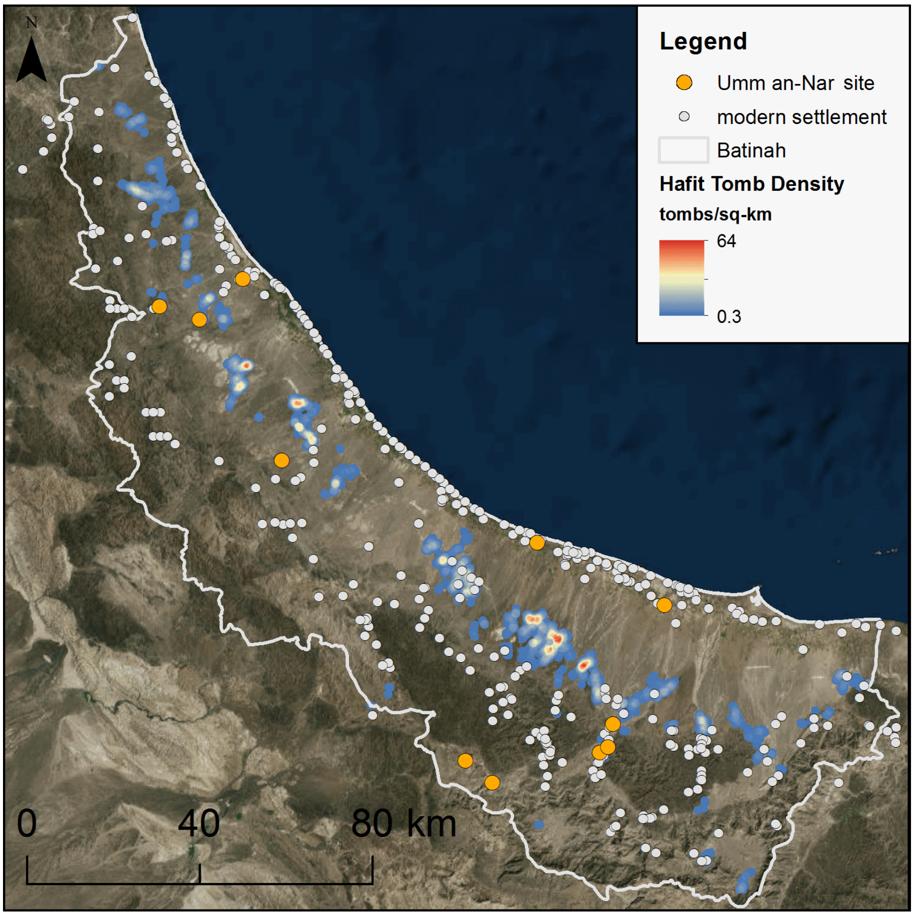


Figure 8.2: Distribution of B-GE Hafit tombs, modern settlements and known Umm an-Nar sites

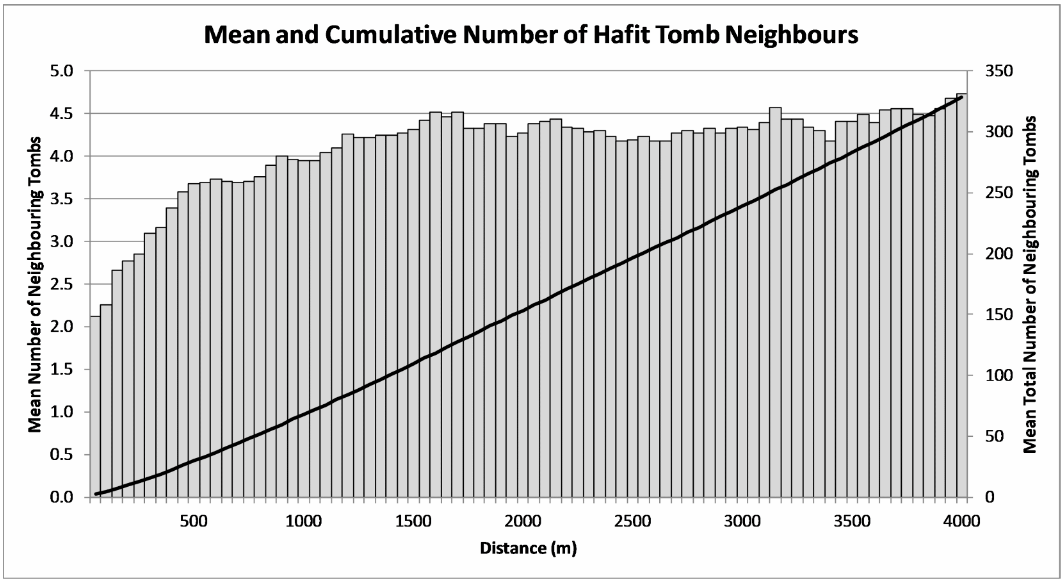


Figure 8.3: The mean and mean cumulative number of Hafit tomb neigbours over a 4km distance

8.1.4 Nomadic settlement remains in the Batinah and beyond

The archaeological remains recorded during the Desert Surface Survey (DSS) at al-Buyraq strongly suggest occupation of the site by a nomadic rather than a sedentary population, and are consistent with a Hafit date (Chapter 7). During the DSS hundreds of ephemeral stone features were observed — arrangements of wadi cobbles and rocks on or embedded in the desert pavement, surrounded by large numbers of Hafit tombs on hills and ridges on three sides of the site. These included a large number of rough stone rings that resemble simple hearths, hut-circles or tent-rings, small rock piles, straight and curved wall sections, small platforms, and other diverse features. The distribution of these features over the small area is patchy but fairly ubiquitous, and is most dense at specific points adjacent to the small wadi beds that run through the survey area; this is consistent with a camping ground used repeatedly over a prolonged period with a large area in use but particularly advantageous positions reused repeatedly. The site is virtually aceramic, yielding only the sherds of a single Late Islamic vessel and one degraded Middle Islamic sherd. It produced only a small assemblage of low quality, non-diagnostic lithics. More numerous and distinctive assemblages would be expected from a Neolithic settlement (e.g. Lemée et al. 2013; Uerpmann, de Beauclair, et al. 2012). Along with the large number of Hafit tombs in the immediate vicinity, this evidence is suggestive of a Hafit date for the site. Moreover, similar stone features have been observed in other Hafit cemeteries in the Batinah: they were noted in the environs of two of the three Hafit sites that were recorded in detail (Chapter 6.4.2, 6.4.3), as well as at two Hafit cemeteries that were visited during B-GE survey ground-truthing (Appendix B.3). Further afield, similar remains have been recorded also associated with Hafit tombs. In Wadi ‘Andam al-Jahwari reported “platforms of piled and paved stones near... [Hafit] cairns” at at least eight separate sites including circular, square and rectangular examples (2013b: 59). Similarly in western Ja’alan, al-Jahwari and his SQU team reported “stone piles, foundations and possible platforms” in close proximity to Hafit tombs and consisting of one or two courses of wadi cobbles forming a circular, oval, rectangular, square or amorphous shape (al-Jahwari 2013a: 163–164). Similar examples were reported by the Joint Hadd Project, they observed that large and medium Hafit necropolises frequently contained ephemeral archaeological remains including “hearths, circular and semi-circular structures, rectangular structures, and alignments” (Giraud and Cleuziou 2009: 173; Giraud 2010: 77). None of the remains could be dated with certainty, but they are generally akin to the features recorded during the DSS (Figure 8.4).

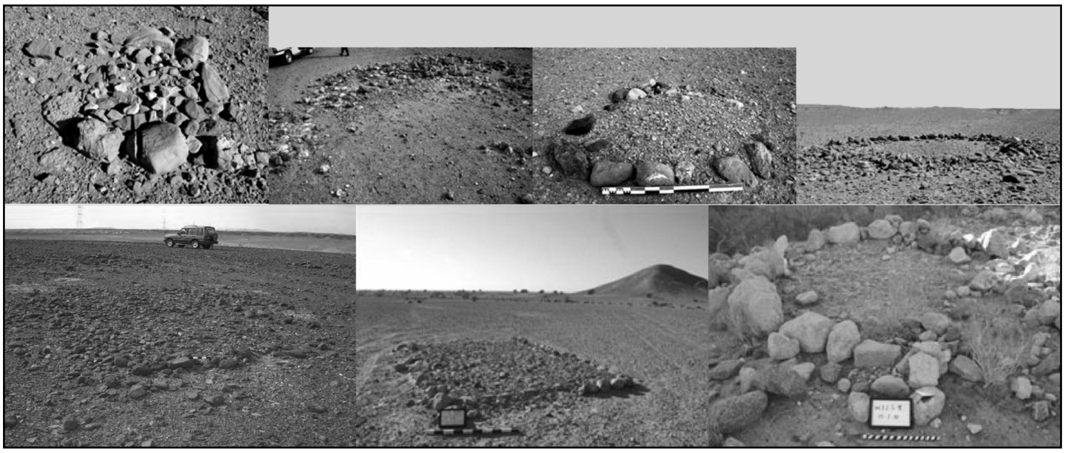


Figure 8.4: Ephemeral stone features recorded in Hafit cemeteries in Wadi ‘Andam and Ja’alan (altered after Giraud 2010: figure 6; al-Jahwari 2013a: figure 16)

These ephemeral stone features associated with Hafit cemeteries bear no resemblance to Umm an-Nar settlement structures (Figure 8.5): monumental, round-towers of mudbrick and stone, 20m or more in diameter and several metres in height (Cable and Thornton 2013); and sizeable, planned, rectangular domestic structures of mudbrick or stone, often laid with skill and precision (e.g. Frifelt 1995: 12, plan 1; Weisgerber 1981: 191–197).

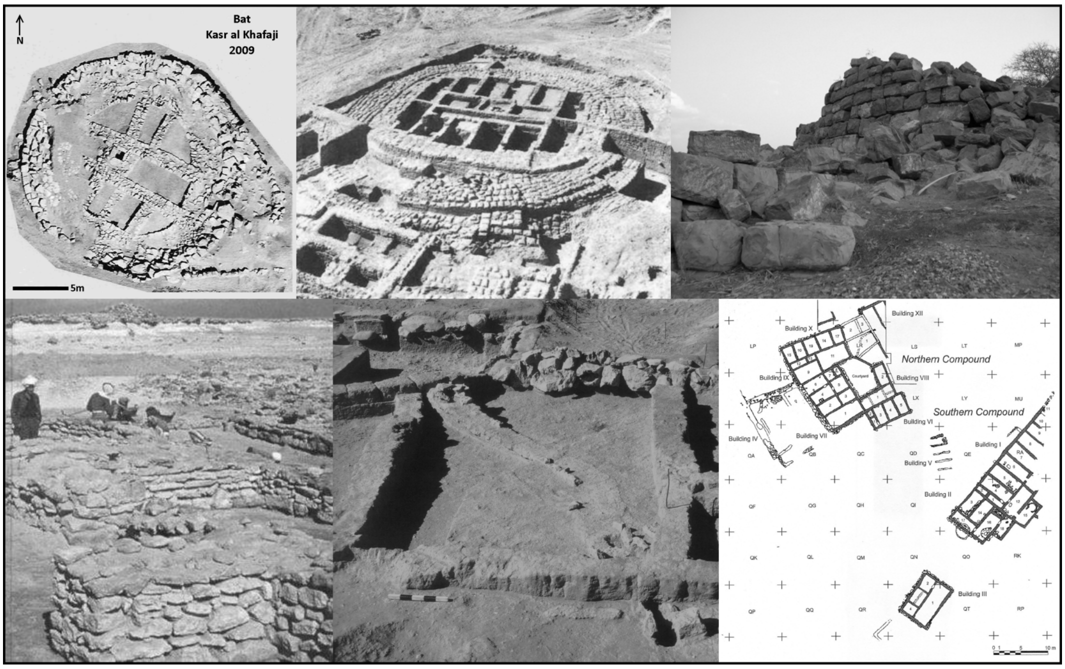


Figure 8.5: Umm an-Nar round-towers and domestic structures, altered after from top-left (Possehl et al. 2009: figure 8; Cleuziou 1989a: plate 21; author’s photo; Frifelt 1995: cover; Cleuziou and Tosi 2007: figure 228; 2000: figure 5)

The DSS features are comparable to Neolithic settlement remains in the region. Neolithic domestic structures appear to have been mainly constructed of wood and other organic materials supported by postholes, trenches or stone foundations[1]. In some cases the original form of the stone or posthole structures is unclear as with the 4th millennium BC phase of RJ-2 (Cleuziou and Tosi 2000: 28, plate 5), the stone remains at FAY-NE15 (Uerpmann, de Beauclair, et al. 2012: 391, figure 7), and the muddled collection of ~150 postholes at Akab (Charpentier and Méry 2008: 122–123, figure 7). Elsewhere the architecture is more obvious, consisting almost exclusively of circular, oval or semi-circular structures — many with hearths inside or outside — that are highly reminiscent of the DSS remains (Figure 8.6). At KHU-2 a 4th millennium BC domestic structure is apparent from a curved channel 4m in diameter, with postholes apparent in the interior and exterior (Charpentier, Berger, et al. 2012: 69, figre 17). Similar round channel or posthole structures have been reported at RH-5 (Marcucci et al. 2011: 208–210), HD-5 (Borgi et al. 2012: 31–32, figure 5), SWY-1 (Charpentier, Marquis, et al. 2003: 11), SWY-2 (Charpentier, Blin, et al. 1998: 24, figure 1), Dalmah (Beech and Elders 1999: 17), and KHB-1 (Cavulli and Scaruffi 2012: 407–408). Similar stone circular or oval structures have been observed at Wadi Shab (Gaultier et al. 2005: 1–2), Kharimat Khor al-Manahil (Kallweit, Beech, et al. 2005: 102) and SWY-1 (Charpentier, Marquis, et al. 2003: 11). The single closest parallel to the DSS hut-circles/tent-rings are two features recorded at KHB-1: one is badly disturbed, but hut 11 consists of a nearly complete circle of stones, 2.5m in diameter with an opening to the southeast and an external embedded hearth — the excavators interpret the two features as tents or lightweight tent-like shelters in which the stones would have anchored a vegetation or animal skin covering to the ground (Cavulli and Scaruffi 2012: 409–410). A feature at the 5th millennium BC site of RJ-39 is also very similar — a rough circle of stones about 4.5m in diameter with a small fireplace a few metres away (Charpentier 1999: 29, figure 2). Moreover, structures that resemble the "rough stone semi-circles" observed at al-Buyraq have also been recorded at 5th and 4th millennium BC Neolithic sites. KHB-1 boasts open semi-circular shelters, ~2m in diameter and dug as channels, with hearths located just outside (Cavulli and Scaruffi 2012: 409–410); c-shaped structures were observed excavated into the bedrock of the cape at RH-5 (Biagi and Nisbet 2006: 225). At Jabal al-'Aluya one of many stone u-shaped structures was excavated, measuring 2.5 by 2.7m (Lemée et al. 2013: 202). GAS1 yielded both stone and channel-dug semi-circular structures (Usai 2006: 276). At many of these sites other features were observed that are also common at al-Buyraq including hearths, rock piles, linear

[1] although the 5th millennium BC, well-built, apse-ended oblong structure with beech-rock walls excavated at Marawah is a unique exception (Beech, Cuttler, et al. 2005: 40–43)

alignments, small rectilinear features and small stone platforms (Méry and Charpentier 2002: 183; Borgi et al. 2012: 29; Cavulli and Scaruffi 2012: 407–410; Biagi and Nisbet 2006: 225; Lemée et al. 2013: 197; Uerpmann et al. 2000: 229).

Although exhibiting clear architectural similarities to the DSS features, unlike al-Buyraq these Neolithic sites yielded a plentiful and distinctive lithic assemblage — and often other artefacts such as soft stone jewellery — clearly diagnostic of the 4th or 5th millennium BC (e.g. Usai and Cavallari 2008). Having such clear similarities to Neolithic material remains, and yet lacking either a plentiful and diagnostic lithic assemblage or pottery, there is a good case for a Hafit date for the site. Neolithic subsistence was based around a combination of domesticated caprids, hunted terrestrial, and marine resources (Beech and Elders 1999: 19; Uerpmann and Uerpmann 2000; Charpentier, Blin, et al. 1998), and it has been suggested that at least part of the population migrated seasonally (Uerpmann et al. 2000: 232–233). Continuation of a similar nomadic pastoralist lifestyle in the Hafit period would be consistent with the similarities observed between 5th and 4th millennium BC settlement sites, and the results of the DSS along with other similar Hafit settlement evidence.

Moreover, the DSS results are not consistent with similar research examining the material remains of more recent nomadic groups. Cribb's seminal study of pastoral nomads in Turkey and Iran revealed architecture that is much more substantial and sophisticated than that recorded at al-Buyraq (1991). The Crowded Desert Project's survey of the Meleiha/Umm al-Ma'a area in Qatar revealed clear evidence for tents, camps and enclosures from the Islamic period that are much larger and more regular than the DSS features, and yielded a steady number of pottery and glass finds (Lopez and Roberts 2016; Lopez, Morabito, et al. 2015).

8.1.5 Exploitation of the coast

The importance of coastal resources to Hafit subsistence appears to have varied across the northern Oman Peninsula. The results of the NOP-GE survey revealed three distinct patterns across the study area. Hafit tombs are absent from large stretches of the Omani-Emirati coastline — of the 123 coastal grid squares, Hafit tombs were only observed in 26 (20.6%), and the vast majority of these are located in the east (Figure 8.7). The large wadi basin territories of the interior are a considerable distance from the coast, and the sea is unlikely to have played a significant role in Hafit subsistence in these areas. Although, inland Hafit tombs have yielded sea shells and sea shell-based beads and jewellery (e.g. Benton and Potts 1994: 50–51; Cleuziou, Vogt, and Méry 2011: 36), testifying to coastal trade links which may have included food goods. In the Batinah — discussed in greater detail below — Hafit tombs are distributed in a band that

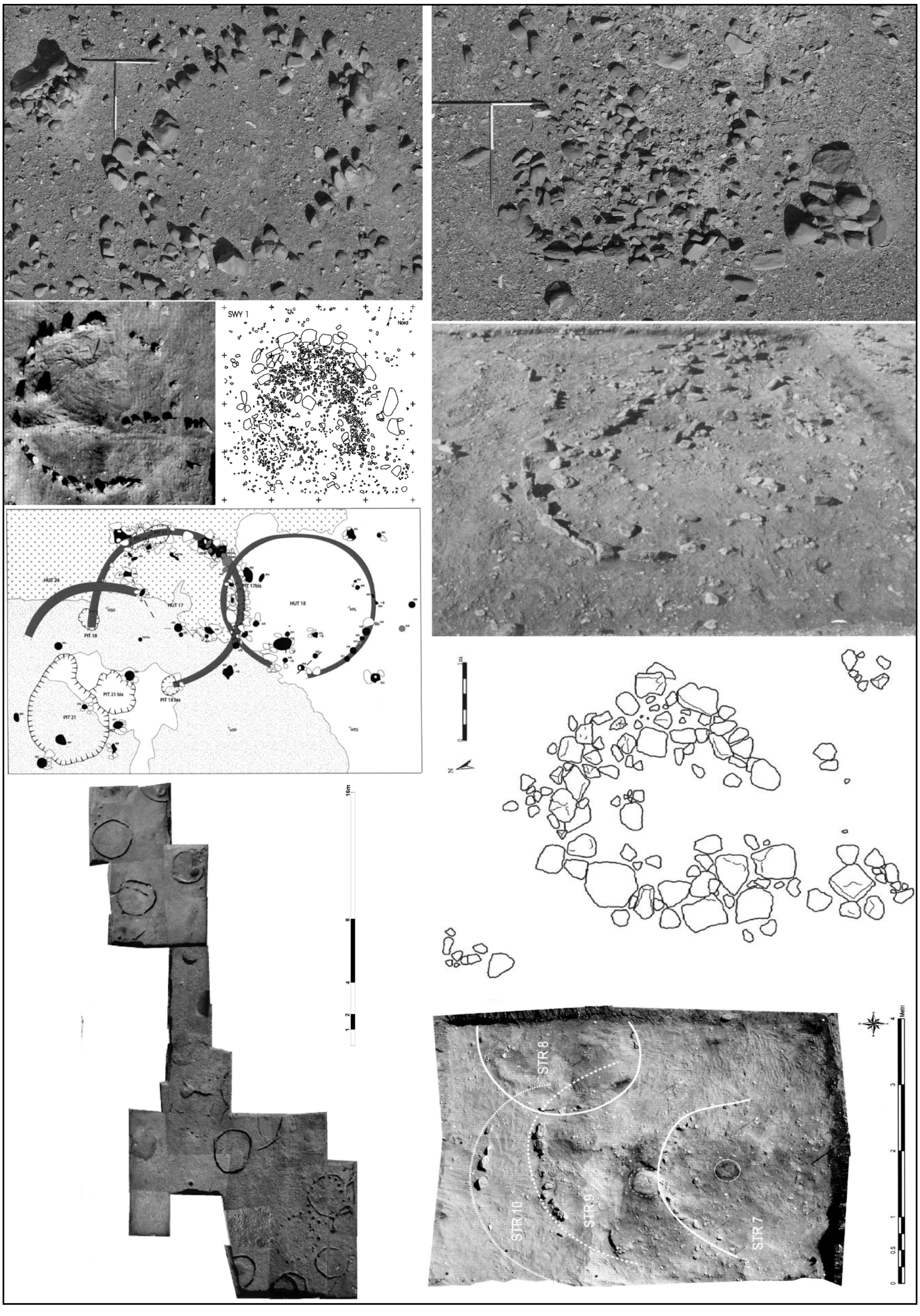


Figure 8.6: Comparing tent-ring and stone semi-circle from al-Buyraq (above) to excavated Neolithic domestic structures (altered after Cavulli 2004: figure 19; Charpentier, Marquis, et al. 2003: figure 6; Marcucci et al. 2011: figure 8; Cavulli and Scaruffi 2012: figure 3; Usai 2006: figure 6; Lemée et al. 2013: figure 4; Cavulli 2004: figure 16)

is close but not adjacent to the coast. Large numbers of tombs were observed on or near to the Sharqiyah coast — the easternmost part of the survey area — and here marine environments are likely to have been crucial to subsistence. Interestingly, the Sharqiyah is the only area in which the coast overlaps with the lower foothills of the Hajar Mountains — where the highest densities of Hafit tombs are generally seen. The Joint Hadd Project has uncovered evidence of Hafit coastal exploitation in Ja'alan (eastern Sharqiyah), taking advantage of the rich environment of large lagoons and mangrove swamps that would have thrived in the slightly higher sea levels of the time, and the rich fishing grounds of the Arabian Sea that lie close to land in the winter (Berger et al. 2005; Lézine, Saliège, et al. 2002; Cleuziou 2007b: 214–215). Hafit tombs in Ja'alan are concentrated along the coast and visibly mark the position of obvious fishing beaches and lagoonal sites (Cleuziou 2003: 139; Cleuziou and Tosi 2000: 26). Hafit tomb grave goods from RJ-6 and HD-10 include shells; rings, beads and pendants made of shell; and perforated shark teeth (Santini 1987a: 33–34; Salvatori 2001). Levels underlying the Umm an-Nar settlement of RJ-2, dating to the late 4th millennium BC, yielded shell hooks and turtle bones from a hearth (Cleuziou, Reade, et al. 1990: 11).

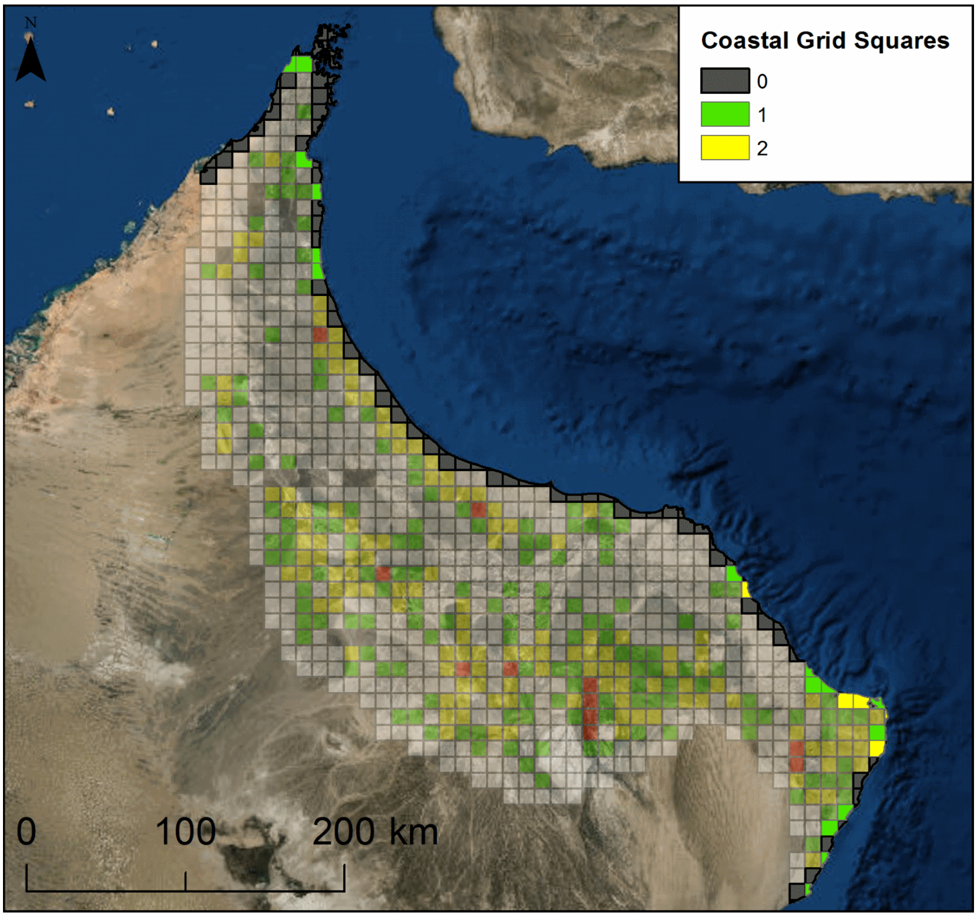


Figure 8.7: NOP-GE survey coastal grid squares

The relationship between Hafit tombs and the coast in the Batinah is unique. The results of the NOP-GE and B-GE surveys reveal that the vast majority of Hafit tombs in the Batinah are situated in a band that runs parallel to the coast, but does not touch it (Chapter 4.3.3, 5.3.3). The qualitative observations and GIS analysis of Hafit tomb distribution demonstrate that no Hafit tombs are located at sea level or within 5km of the coast (Chapter 5.4.3). However, the vast majority are located between 6 and 34km of the sea, between an hour's and a day's walking distance. The short distance from the low hills of the bajada to the coast makes it very possible that the Hafit population supplemented their diet with marine food resources. There are four possible interpretations: 1) the Hafit population did not exploit the coast; 2) they occasionally exploited the coast but spent relatively little time there; 3) they exploited the coast intensively, but transported their dead back to cemeteries in the bajada hills; or 4) they exploited and occupied the coast intensively but disposed of their dead differently in this environment. Although not as ecologically diverse as the eastern coast of Oman (Uerpmann 2003: 77; Costa 1988a: 3), the Batinah coast boasts rich fishing resources that partially explain the density of recent/traditional settlement in the littoral zone (Wilkinson 1977: 8), and supports over a third of Oman's traditional fishermen (al-Oufi et al. 2000: 423). The coastal shelf of the Gulf of Oman experiences upwelling of cold water in the summer months caused by the southwest monsoon, the combination of this mineral-rich water and strong sunlight supports a rich food chain of phytoplankton, small fish and larger predators — over 300 finfish and invertebrate species (Wilkinson 1977: 19; McIlwain et al. 2011: 497). Historically, the Batinah population migrated less than other coastal communities of the Oman Peninsula, because the rich fishing and agriculture were able to support a permanently sedentary population (Wilkinson 1977: 26). It seems almost impossible that the Hafit population would have ignored this rich resource, living so close to it. While some 5th millennium BC sites were located inland, every known site from the 4th millennium, preceding the Hafit period, is coastal (Figure 8.8, Appendix C), possibly as a result of climatic deterioration leading to arid conditions from ~4,000 BC (Uerpmann 2003: 74–76). Indeed, there is direct evidence for the exploitation of marine resources during the Hafit period — up to ten shell middens across five sites are known to have been in use during the late fourth and early third millennia (Figure 8.8, Table 8.1); two of these sites are located not far from the eastern edge of the Batinah plain. Modern exploitation of the Batinah coast centres around agriculture, exploiting suitable sediments of the distal plain and the high freshwater table (see Introduction), it is even possible that this began in the Hafit period although it is difficult to see how this could be established.

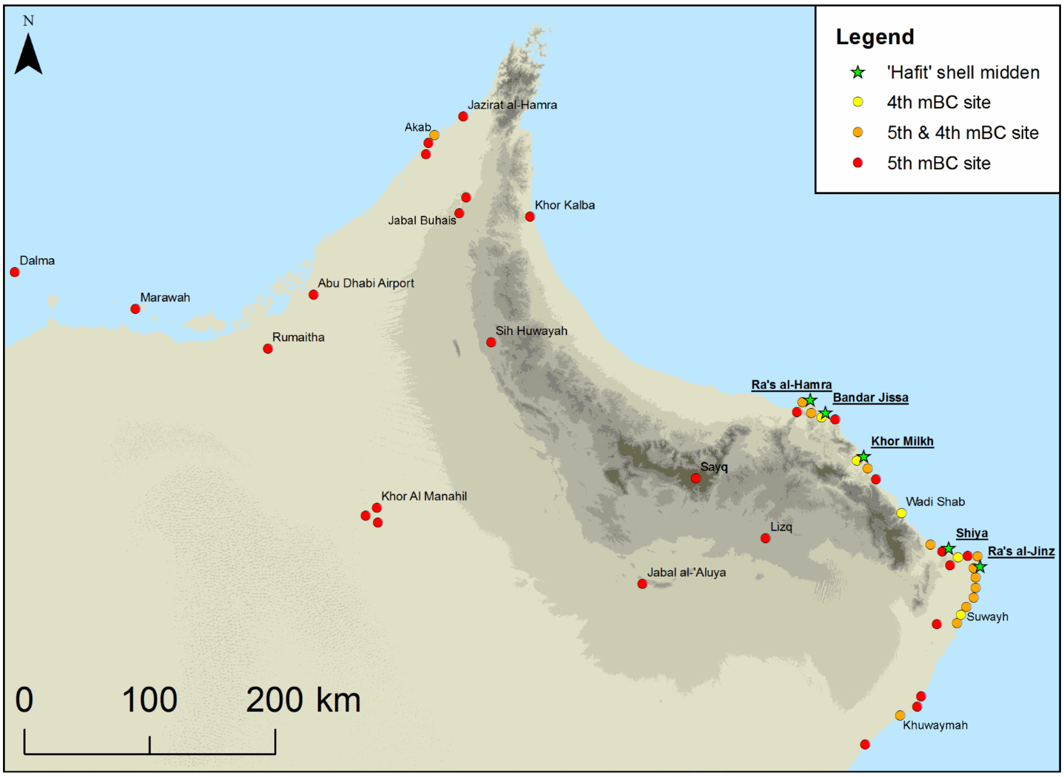


Figure 8.8: Map of shell middens in use during the Hafit period, and 5th and 4th millennium BC Neolithic sites

Table 8.1: Shell middens in use during the Hafit period

Site	Code	Material	Sample ID	Date (cal. BC)	Reference
Ra's al-Jinz	RJ-2	shells	Beta 25906	3,510–3,044 [2σ]	(Biagi 1994: table 4)
			Beta 25907	3,609–3,050 [2σ]	
Shyia	SHI-3	shell (*Andara*)	Bln-3650	2,866–2,590 [1σ]	(Biagi 1994: table 4)
Ra's al Hamra	RH-10	charcoal	Hv-13197	3,334–2,947 [1σ]	(Biagi 1994: table 2)
	RH-4	charcoal	P-2741	2,610–2,488 [1σ]	(Biagi 1994: table 2)
		charcoal	P-2740	3,210–2,680 [1σ]	
	RH-3	charcoal	P-2673	2,639–2,489 [1σ]	(Biagi 1994: table 2)
			P-2738	3,010–2,480 [1σ]	
	RH-1	shell	Hv-12977	3,410–3,100 [1σ]	(Biagi 1994: table 2)
Khor Milkh	KM-2	shells (*Ostrea*)	Hv-15745	3,371–3,038 [2σ]	(Uerpmann and Uerpmann 2003: 131)
			Hv-15746	3,617–3,021 [2σ]	
Bandar Jissa	BJ-1-3	parallels with RH lithics & corroded Cu fragments			(Uerpmann and Uerpmann 2003)

The likely Hafit exploitation of the coast highlights a major problem that might undermine attempts to understand Hafit society better — to what extent does the distribution of Hafit tombs represent the areas that were occupied by the Hafit population? In contrast to the coast, the dearth of Hafit tombs in much of the mountains and foothills of the Batinah is more convincingly indicative of a lack of Hafit exploitation in these areas, where the construction of Hafit tombs is possible. The Batinah coast is flat and sandy — the lack of rock and high ground preclude tomb building. If the coast was exploited during the Hafit period, then the population either transported their dead back to bajada hill cemeteries, which is possible but seems unlikely given the distance, or followed alternative funerary practices. Either way as we are unable to map the occupied areas easily we may face the problem of a "missing Hafit" on the Batinah coast and in flat coastal areas more widely in the northern Oman Peninsula.

8.1.6 Seasonality

The movements of a mobile Hafit population are likely to have been partially governed by the seasons, as those of the Neolithic population appear to have been (Uerpmann et al. 2000: 232–233). Cleuziou has put forward an argument for seasonal migration in the Hafit population in the Ja'alan, the easternmost region of Oman. He argues that Hafit communities moved from the coast in the winter — where they fished and exploited a rich marine environment — to either grazing lands around major wadis or to oasis settlements inland in the summer (Cleuziou 2007b: 215; 1998: 63; Cleuziou and Tosi 2000: 67). However, this is based on modern ethnographic parallels and climate conditions rather than archaeological evidence (Cleuziou 2007b: 214–215; Cleuziou and Tosi 2007: 93). Tomb architecture at Halban may provide direct evidence for the seasonal movement of the Batinah Hafit population. Six of the twenty-eight Hafit tombs have entrances and all point approximately south-east (Chapter 6.4.1). There is no obvious landscape feature in this direction, but it matches the azimuth of the sun — either towards sunrise, or away from sunset. The path of the sun varies over the course of a year — at the Spring and Autumn Equinoxes it rises due east and sets due west, but at midsummer in Halban it rises at ~65°(ENE) and sets at ~295°(WNW) and at midwinter it rises at ~115°(ESE) and sets at ~245°(WSW)[2]. If Hafit occupation of Halban was permanent — or nomadic but independent of the seasons — you would expect tomb entrances to vary between ESE to ENE, but as they all point southeast it may suggest that occupation of Halban was seasonal, at least for a part of the period: either in the winter if tomb entrances were oriented towards the sunrise, or in the summer if they point away from sunset. This evidence complements a much larger analysis of Hafit tomb entrances at three sites in Wadi 'Andam by the present author. The vast majority of the forty-two surviving tomb entrances surveyed fell within the annual variation in sunrise azimuth, and differences between the sites suggested seasonal migration of the Hafit population — spending winter in the mountains and summer on the plains (Deadman 2014). Indeed, the vast majority of Hafit tomb entrances across the eastern part of the northern Oman Peninsula show a

[2]calculated using the Sun Position Tool at http://www.sunearthtools.com/dp/tools/pos_sun.php

similar relationship with the seasonal position of the rising or setting sun (Figure 8.9, Appendix D). The orientation of tomb entrances at Halban and elsewhere may suggest a seasonal component in the movements of the nomadic Hafit population.

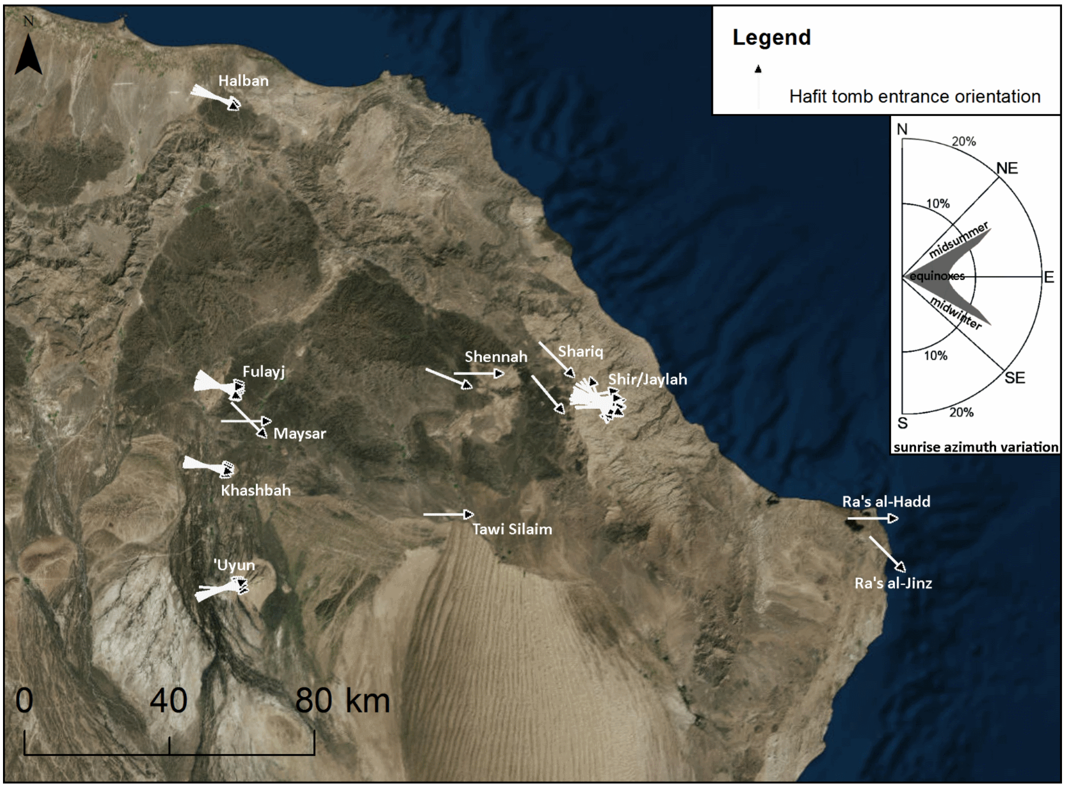


Figure 8.9: Map of the orientation of Hafit tomb entrances in the northeastern Oman peninsula, based on fieldwork and literature (Appendix D)

8.1.7 Changes in subsistence

Although the data points towards a primarily nomadic pastoralist Hafit population in the northern Oman Peninsula, some evidence may also testify to change in Hafit subsistence and lifestyle over the course of the period. Certainly by the Umm an-Nar period most if not all of the population had adopted a fully sedentary lifestyle centred around arable agriculture (al-Jahwari 2009) — the transition between the two is apparent in the Hafit funerary dataset. The three Hafit cemetery case study sites of Halban, Wadi al-Hoqain and al-Hamid are not typical of the Batinah and may provide insight into developments in the lifestyle of the Hafit population through their funerary practices (Chapter 6.5). Typical Batinah Hafit tombs — like those recorded during B-GE survey ground-truthing (Chapter 5.2.2, 5.3.2) — are between four and five metres in diameter and are in a relatively poor condition that reflects their fairly rough construction. In contrast the tombs at the three Hafit cemeteries studied in more detail are generally larger, in much better condition and clearly suggest that greater care, effort and skill were applied to their construction (Chapter 6.4.1–6.4.3). One tomb at each site is of singularly large proportions — between nine and ten metres in diameter, twice the size of an average Batinah Hafit tomb. Moreover, significant effort was taken in facing the tombs at these three sites — either through careful selection of blocks and use of plugging stones or even roughly working the masonry. The density of Hafit tombs at Halban and al-Hamid is unusual — GIS analysis of Batinah Hafit tombs revealed that tombs have three to four neighbours within 100m on average and that a large proportion have none at this distance (Chapter 5.4.3); Halban boasts two clusters of nine and 17 tombs each within 300m of each other and al-Hamid a single cluster of 13 tombs. Although the Wadi al-Hoqain cemetery is more typical in terms of tomb density, it is unusual as it lies well outside of the dense 'Batinah band'. The careful construction, above average — and in some cases enormous — proportions, intricate facing and unusual density of tombs at each of these three cemeteries all suggest that the local Hafit populations spent unusually lengthy periods of time at these sites. Elsewhere in the Batinah Hafit tombs are small, utilitarian and thinly distributed — suggesting that relatively little time was spent in any single location, and that tombs were constructed quickly and as they were needed. The more crowded and elaborate Hafit tombs of Halban, al-Hamid and Wadi al-Hoqain suggest that the local population spent longer periods at these sites, requiring more burial space and allowing greater effort to be devoted to tomb construction. This may demonstrate changes in the mobility, perhaps even a gradual sedentarisation, of the Hafit population in the Batinah — with the groups' occupation of their territory being increasingly concentrated towards specific sites, with visits increasing in length. Each of the three cemeteries is located in close proximity to one or more sources of fresh water — either a sizeable wadi or the Tertiary aquiclude — as well as copper ore deposits, which may indicate why these sites were of particular interest. Moreover, the Hafit tombs at each cemetery are not located on the highest ground available, as is usually the case, but in an area that is suited to building larger funerary structures (Figure 8.10). This may reflect a diminishing need to proclaim ownership of land or resources as the less mobile population was now more frequently present to defend it. Halban and Wadi al-Hoqain are both located a short distance from modern agricultural villages — it may be speculated that partial sedentarisation may have run parallel to the development of agropastoralism, itself an intermediate stage to the true arable agriculture of the Umm an-Nar period. The independent nomadic pastoralist strategy followed for much of the Hafit period may have transitioned to semi-nomadic agropastoralist subsistence towards the end of the period, and then a fully mixed sedentary agricultural and pastoralist economy by the start of the Umm an-Nar period. Observations of Hafit tomb architecture and distribution elsewhere in the northern Oman Peninsula may also testify to similar changes in Hafit lifestyle and subsistence. The 'beehive' — or Bat-type — cemetery at Bat is a dense collection of tombs that are larger, better built, located on lower ground, and carefully faced compared to the tombs on the surrounding hills (Böhme 2011; Frifelt 1975a). A "transitional" Hafit tomb was excavated near Kalba that is much larger than others that were excavated and boasts a central supporting wall — an additional architectural feature that foreshadows multi-chambered Umm an-Nar tombs (Eddisford and Phillips 2009). Survey and excavations around al-Khubayb revealed a trend in Hafit tombs of increasing size, build-quality, the addition of supporting walls and increasing interment numbers that testifies to the movement towards agropastoralism in the Early Bronze Age (Williams and Gregoricka 2013).

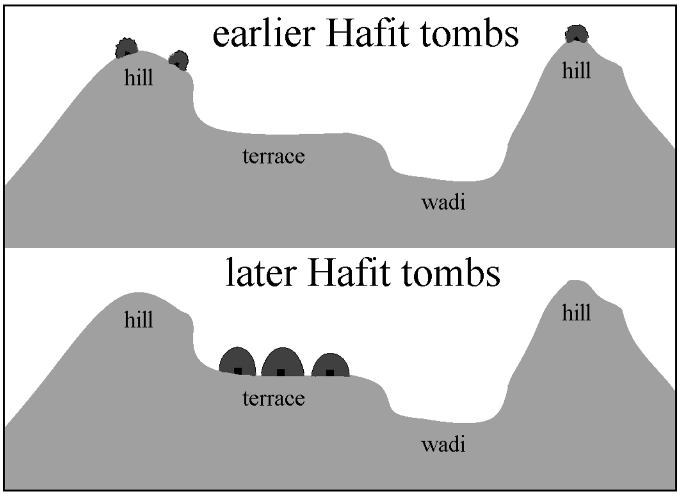


Figure 8.10: Schematic diagram of tomb development over the course of the Hafit period in the Batinah

The findings of the NOP-GE survey may also testify to sedentarisation and shifts in subsistence strategies taking place elsewhere in the northern Oman Peninsula (Chapter 4.6). The results reveal a small number of '3' grid squares, surrounded by '2' and '1' squares forming territories that generally correspond to individual wadi basins. While the difference in the number and ubiquity of Hafit tombs between '1' and '2' squares is small but significant, the average '3' square boasted nearly nine times as many tombs as the average '2' square and almost three times the ubiquity. These high-density grid squares may have been territory centres or natural crossroads in the paths that the local population took as they moved through their range and therefore boast a higher-than-normal number of Hafit tombs, but it may also be attributed partially to the diminishing mobility of the population in the latter part of the Hafit period — marking the location of favoured occupation areas where more time was being spent, including well-known examples such as Bat, Bisya and al-Khashbah. In his extensive ground survey of the Wadi 'Andam area al-Jahwari observed an interesting difference in the distribution of

‘Hafit cairns’ and Hafit ‘beehive tombs’ — a largely architectural distinction that may be chronological with the latter being a transitional type (al-Jahwari 2013b: 23–24). He asserts that beehive tombs are located on hills and outcrops surrounding modern villages, while Hafit cairns populate gravels hills and wadi terraces (al-Jahwari 2013b: 63, table 26), although it is possible that the distinction is entirely the result of differences in the quality of the building material related to local geology (Vogt 1985b: 58–105). Hafit sedentarisation over the course of the period may also explain the spatial relationship between the number and ubiquity of Hafit tombs as mapped by the NOP-GE survey and the location of Umm an-Nar sites — on average ‘3’ grid squares are located closer to known Umm an-Nar sites and major Umm an-Nar settlements than all other squares, despite analysis based on an incomplete dataset. This spatial relationship — close, but not close enough to suggest unbroken Early Bronze Age continuation of settlement — is consistent with a population altering their subsistence strategy and settlement patterns from nomadic pastoralism, through semi-nomadic agropastoralism, to sedentary arable agriculture. This evidence suggests that the major changes in Early Bronze Age society occurred towards the end of the Hafit period (Rouse and Weeks 2011: 1586; al-Jahwari 2013b: 160; Williams and Gregoricka 2013: 146; Magee 2014: 96–97), rather than in a ‘great transformation’ at its outset (Cleuziou 2007b: 211; Giraud 2009: 742; Cable 2012: ii).

It is here that the small, but significant body of evidence of more substantial Hafit settlements may naturally fit into the picture. Compared to the abundance of the funerary archaeology, Hafit settlements are very rare (Chapter 1.1.1). It is possible that these settlements begin to appear towards the end of the Hafit period, as the population begins to focus their occupation at particular sites. This may have started with a few, simple domestic structures of stone and mudbrick at favoured seasonal fishing grounds as at HD-6 (Azzara 2013; 2009), or important grazing areas or early gardens as at ALA-2 (Blin 2007) and Bat 1146 (Thornton et al. 2013) in the latter part of the Hafit period, culminating in the first full sedentary settlements complete with early round-towers in the very late Hafit or early Umm an-Nar period as at Hili-8 (Cleuziou 1989a; Potts 1997: 66–67) and Bat 1147 (Possehl et al. 2011: 4–13). Even if the case for an earlier Hafit date for some of these sites is clearly proven in the future, it appears that such sedentary or semi-sedentary occupation was not the standard model for most of the northern Oman Peninsula for much of the Hafit period.

8.2 The wider economy

The findings presented in previous chapters have much to add to the discussion of the wider Hafit economy including the role of copper, and local and international trade in Hafit society, as well as the emergence of specialisation and new skills in the local population.

8.2.1 Copper

Copper was central to Hafit society, especially in the Batinah, to the extent that it appears to have partially dictated Hafit occupation of the landscape. The NOP-GE survey (Chapter 4.5.2) demonstrates that Hafit tombs are concentrated in grid squares that contain or neighbour copper ore sources (Figure 8.11) — on average '3' squares are almost twice as close to copper sources as '0' squares. Such a link has been suggested, but not proven, already in the literature (Gentelle and Frifelt 1989: 124). There is a possibility that this spatial correlation is coincidental — that copper is more likely to occur in areas favoured by the Hafit population for other reasons — or a 'happy accident' — that preferred areas happened to overlap with copper deposits. However, copper tools — including pins, needles and knives — are frequently recovered from excavated Hafit tombs across the northern Oman Peninsula, while copper jewellery is scarce (Chapter 1.1.2), demonstrating that the metal played an important role in the Hafit economy. Until very recently (Schmidt and Döpper 2017), direct evidence for Hafit copper mining and smelting was lacking (Magee 2014: 96; Weeks 2003: 24), but the widespread occurrence of copper tools in Hafit tombs and the overlap in their distribution with that of copper ore sources is strong circumstantial evidence. Moreover, Hafit tombs are largely absent from northern and eastern parts of the U.A.E. (Chapter 4.6). These regions boast the foothill topography favoured by the Hafit population in the south, but lack exploitable copper ore sources. Although copper mineralisations have been reported here, they are found within the Hawasina series rather than the ophiolite and therefore make poor sources of ore — indeed, there is no evidence for the smelting of these deposits in eastern Arabia in any period (Weeks 2003: 14).

The overlapping distribution of Hafit tombs and copper ore sources is stronger in the Batinah than in the northern Oman Peninsula as a whole (Chapter 5.4.3). Hafit tombs are located in much closer proximity to copper ore than the landscape average — 80% are found within 8km of a source, an area that makes up just over half of the region as a whole, on average they are less than 5km from copper ore. The three most impressive Hafit cemeteries surveyed — in terms of tomb density and architecture — are all located less than 3km from a known copper ore source (Chapter 6.5). Generally Batinah Hafit

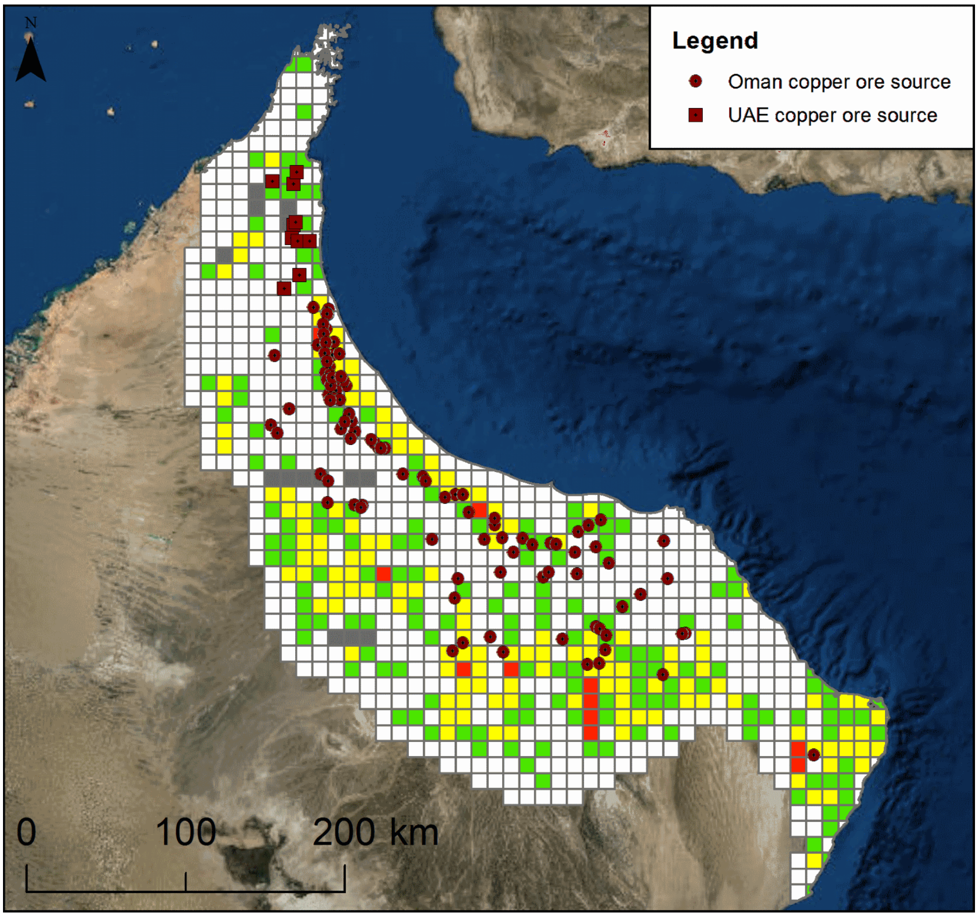


Figure 8.11: NOP-GE survey results and the distribution of copper ore sources

tombs are not found densely distributed around copper ore sources, and never in such numbers and density to suggest permanent or full-time smelting — rather the tomb distribution indicates a low level exploitation of the metal, perhaps for domestic consumption and local trade. Favoured Hafit occupation areas near Tertiary outcrops in the bajada are good locations from which to exploit the copper resources situated a few kilometres inland — some of the densest tomb areas are situated between major Tertiary outcrops and large copper ore fields. The richness of the Batinah's copper ore is well documented, as is the archaeological evidence for its widespread exploitation from the Bronze Age to the Islamic period — the ore is easily smelted with only basic metallurgical technology (Hauptmann 1985; Goettler et al. 1976). What remains unclear is the original source of the technology for the Hafit copper industry — southeastern Iran is a likely candidate as a close neighbour that is known to have been producing copper by this time (Weeks 2003: 36; Cleuziou and Méry 2002: 282). The Hafit population supplemented copper tools with a simple lithic industry. The suspected Hafit settlement site of al-Buyraq (Chapter 7) yielded only a small assemblage of non-diagnostic and unsophisticated chert tools despite covering a large area and boasting a large number of anthropogenic features — suggesting that this was a secondary technology. Chert flakes and debitage — but no finished tools — were frequently observed in and around Hafit tombs during ground-truthing of the Batinah survey (Chapter 5.2.2, 5.3.2) and at the cemetery of al-Hamid (Chapter 6.4.3).

8.2.2 Local exchange and international trade

The results of the NOP-GE survey suggest that the region was divided into territories — often overlapping with wadi basins — with tombs more densely distributed in the centre and more sparsely in the peripheries (Chapter 4.6). Territory borders would be natural places for local populations to meet as they ranged, and if their migrations were seasonally determined, as is hinted at by tomb entrances at Halban (Chapter 6.4.1) and Wadi ‘Andam (Deadman 2014), then these meetings could have been predictable and regular. A small, mobile Hafit population — estimated at between 11,000 and 29,000 people (Chapter 4.4.2) — would allow both goods and ideas to spread quickly resulting in a fairly uniform Hafit material culture (Cleuziou 2003: 141). The recovery of sea shells and shell jewellery from tombs on the interior side of the Hajar Mountains — as at Jabal al-Emalah (Benton and Potts 1994: 31) and Tawi Silaim (de Cardi, Bell, et al. 1979: 78–79) — provide additional evidence of a lively local exchange system. Outlying Hafit tombs in the Batinah may reveal the location of trade routes to other regions (Chapter 5.5). The vast majority of the tombs form the ‘Batinah band’ in the low bajada hills, but some lone Hafit tombs and small, isolated clusters are found further south, penetrating the valleys and bowls of the Hajar Mountains. Given the small number of these tombs, and the significant distances that lie between them, it is unlikely that these testify to communities living in these areas. The tombs are adjacent to major wadis that provide natural pathways through the mountainous terrain, and are found between the Batinah tombs and other high-density areas on the other side of the mountains, and therefore they may indicate small bands moving between major communities (see Figure 5.102). Similarly isolated Hafit tombs in a mountain setting are known in other parts of the Oman Peninsula (Cleuziou and Tosi 2007: 117; Schreiber 2004a: 10), which may provide further such evidence.

International trade with Mesopotamia and other regional powers may have made up an important part of the Hafit economy. This has always been a focus of Bronze Age Arabia research, starting with efforts to identify *Magan/Makkan* and *Dilmun* — Akkadian and Sumerian trading partners named in cuneiform texts (e.g. Peake 1928; Bibby 1970; Potts 1978; Weisgerber 1983; Prange et al. 1999). This early written evidence from the Jemdet Nasr and Early Dynastic I periods identifies numerous ships, people, and goods — including copper — with Dilmun, the copper must have had its origins in the northern Oman Peninsula as there is no ore in Bahrain nor the Eastern

Province of Saudi Arabia, the accepted location of the ancient polity (Potts 1990b: 85–92). Chemical analysis of copper-based artefacts in Mesopotamia and Omani copper ores suggest that the regional power imported Omani copper from the end of the 4th millennium BC, but at low levels compared to the mid-late 3rd millennium BC (Begemann et al. 2010: 158–159). Grave goods recovered from Hafit tombs show a clear link with Mesopotamia and other parts of the wider region. Mesopotamian carinated jars are a signature Hafit grave furnishing, providing the first dating evidence for the tombs (During-Caspers 1971). The shape, ware and surface decoration show clear parallels with ceramics from Jemdet Nasr and Early Dynastic sites in Mesopotamia (Potts 1986: 130), more than fifty of these jars have been recovered despite the frequent looting of Hafit tombs demonstrating that there was significant contact with the regional power. Similarly distinctive, diamond-shaped and segmented faience beads that have clear parallels in Mesopotamia and Susa, have been found at a number of Hafit tomb sites from across the northern Oman Peninsula (Cleuziou, Pottier, et al. 1977: 17–19; de Cardi, Bell, et al. 1979: 84; Frifelt 1980: 275; Cleuziou and Tosi 1989: 30; Laursen 2013: 128). However, there is no reason to conclude that this contact indicates direct Mesopotamian control or colonisation as some have suggested (During-Caspers 1971: 43–44; Orchard 1995: 155–156; Ratnagar 2001: 361). The NOP-GE survey results (Chapter 4.3.3) suggest that very little of the coast was occupied during the Hafit period: only a small number of tombs are located on or near the coast on either side of the Musandam peninsula; only the southeast, Sharqiyah coast seems to have been densely occupied. Between these two areas, Batinah Hafit tombs are distributed relatively close to, but never touching the coast. It is possible that access to international trade was part of the attraction of the coast, and that from their bajada territory, at least a segment of the Hafit population could be dispatched to access copper ores further inland and an international market for the metal at the coast. Given the density of Hafit tombs and copper ore in the region it seems likely that the Batinah played an important role in international trade. The sparse distribution of tombs between the Batinah coast and the Arabian/Persian Gulf — within the survey area, and the tiny number of Hafit tomb sites further west known from the literature (Vogt, Gockel, et al. 1989) — may even testify to Batinah-based traders heading towards southeastern Iran, Mesopotamia or Dilmun (Figure 8.12).

8.2.3 Emergence of specialisation

The archaeological evidence points to the emergence of specialisation and new skills in the Hafit population by the end of the period. The vast majority of the Hafit tombs observed and recorded in the Batinah are relatively simple structures — small tombs of

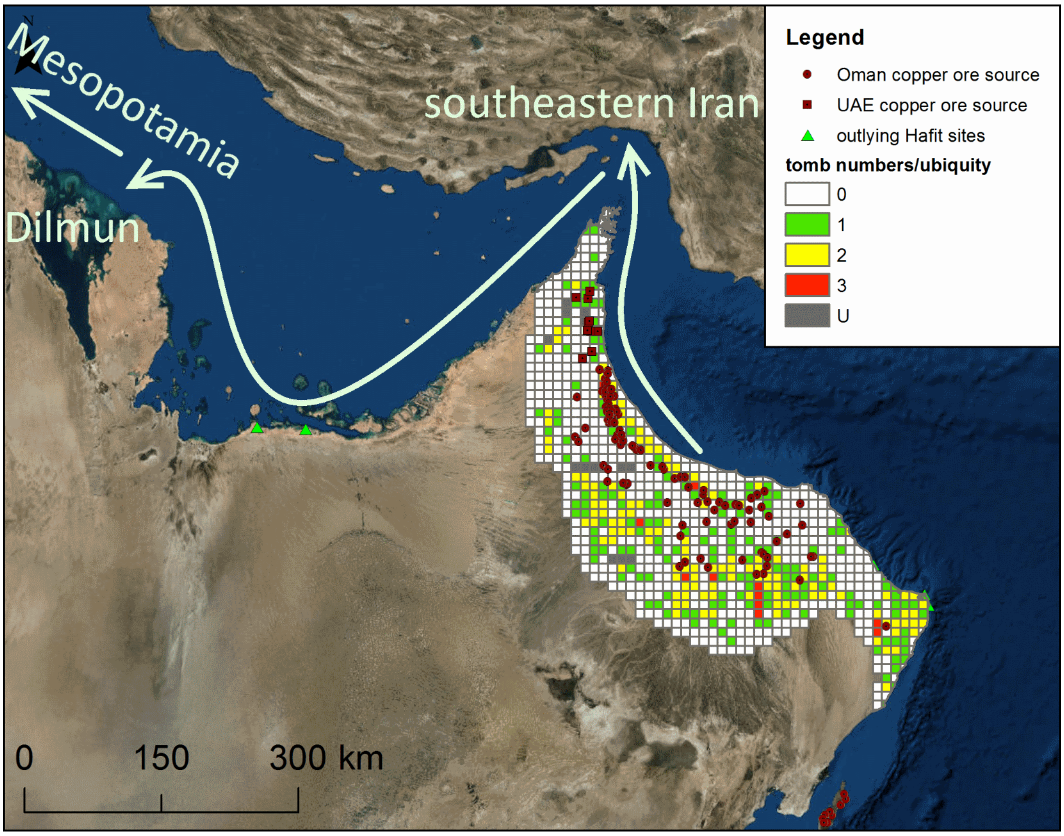


Figure 8.12: Possible Batinah maritime trade routes to major trading partners

unworked stone with few ringwalls and simple construction that does not survive well (Chapter 5.2.2, 5.3.2). However, at three Hafit cemeteries recorded in detail — and a small number of others observed during fieldwork — tomb architecture is very different. The increasing size and build-quality of the tombs at al-Hamid, Halban and Wadi al-Hoqain suggest increasingly greater construction expertise on the part of the Hafit population, while the rough working of facing stones testifies to the development of masonry skills perfected by the Umm an-Nar period (Chapter 6.5). Similar observations have been made in other parts of the northern Oman Peninsula of Hafit tombs becoming larger and more complex over time — most clearly by the SoBO team working near Dhank (Williams and Gregoricka 2013). The unusual density of the tombs and the greater effort made in their construction at the three sites suggest that lengthening periods of time were spent in the area by the local population, perhaps because of the availability of copper ore, and indicating the further development of, and greater concentration on, metallurgical skills. Greater variety and sophistication is apparent in the copper objects recovered from 'transitional' Hafit tombs compared to earlier ones (Chapter 1.1.2): with copper bangles and rings appearing for the first time in these later tombs (Jasim 2012: 128; 2003: 87). Based on agent-based modelling, Rouse and Weeks have argued that specialisation in Hafit society may have led to economic — but not political — inequality favouring the new specialists, and that these individuals and groups with greater wealth would have been natural agents to conduct trade with regional neighbours seeking these new local resources such as copper (Rouse and Weeks 2011: 1589).

8.3 Politics and ideology

The data collected over the course of the thesis adds considerably to the discussion of Hafit politics and ideology, including the political division of the region, expressions of territoriality, the socio-political organisation of the population, ideology and belief systems, and the evidence for social change over the course of the period.

8.3.1 The political landscape of the northern Oman Peninsula

During the Hafit period, the northern Oman Peninsula seems to have been divided into adjacent territories that ring the Hajar Mountains, frequently overlapping with major wadi basins. The NOP-GE survey results revealed that there are clear areas of tomb presence and absence — or at least very low density — and that presence areas cluster together with greater numbers of tombs in the centre and a lower density in the peripheries (Chapter 4.3.3). The larger clusters are adjacent and are centred in the foothills of the Hajar Mountains, stretching into the lower uplands and the low outwash hills overlooking the plains, and tend to overlap with major drainage basins. This is particularly apparent on the southwestern side of the Hajar Mountains. It has been argued here that these clusters represent individual Hafit territories — the range of a single population with a common social entity. Each of the twenty or so territories would boast a small and sparse population of between 500 and 3,000 people — based on the overall population estimate (Chapter 4.4.2) — depending on surface area as they vary between hundreds and low thousands of square kilometres. This picture of the Hafit political landscape is consistent with other published research. Cleuziou has argued that Hafit tombs demarcate Hafit individual territories centred around agricultural land, fishing settlements or pasture (Cleuziou 1997: 407–408; 2002b: 196–197). Giraud's GIS analysis of the distribution of Hafit tombs in Ja'alan led her to argue that the region was split into five major Hafit centres with a tomb-dense core and a sparse periphery (Giraud and Cleuziou 2009: 176, figure 7). Google Earth survey and GIS analysis of Hafit tombs in the Wadi ʻAndam area demonstrated a clear relationship between tombs and the local hydrology, with basins forming natural territories for the Hafit population (Deadman 2012a: 32–33). Territory distribution in the Batinah differs from this model due to the unique hydrology and topography of the region (Chapter 5.5). Rather than clustering within adjacent wadi basins, in the Hafit tombs are distributed in a narrow 'Batinah band' that runs parallel to the line of the coast and the mountains in the bajada zone, making territorial borders more difficult to define. This unique distribution is probably due to the Tertiary ridge aquiclude discussed above. The distribution of Hafit tombs within this bajada band is not entirely uniform — there are often sizeable gaps between groups of tombs. Large groups tend to overlap with the distribution of Tertiary outcrops — hotspots of water and grazing which may have formed the focus of individual territories.

8.3.2 Territoriality

Territoriality is a model that describes the "attempt by an individual or group to affect, influence or control people, phenomena and relationships, by asserting control over a geographic area" (Sack 1986: 19), with such a 'territory' consisting of the land, its natural resources and the human modifications made to it (Zedeño 1997: 72). Although the history of the concept goes back a considerable length of time (cf. Van Valkenburgh and Osborne 2012: 3–7), its modern use in archaeology emerged from new/processual archaeology's novel approach to funerary datasets and in particular the work of Saxe (1970) and Goldstein (1976). The Saxe/Goldstein hypothesis links the emergence of formal cemetery areas with competition for restricted local resources and attempts to control them through claims of lineal descent from the dead (see Introduction). Renfrew's early interpretations of European megalithic monuments describe the structures as territorial markers that divided the landscape at a time of population stress following the adoption of farming in the Neolithic (1976; 1973). Chapman developed this model further by integrating Renfrew's work with the Saxe/Goldstein hypothesis and other detailed contemporary research on territoriality (e.g. Dyson-Hudson and Smith 1978); he explored other phases of imbalance between society and the availability of critical resources from the late Mesolithic to the late Neolithic in Europe and how this was reflected in funerary practices (Chapman 1981). Territoriality was quickly adopted, and adapted, as a means of exploring economic and socio-political structures in a variety of settings (e.g. Madsen 1982; Ingold 1986; Walsh 1998; O'Shea and Milner 2002). However, the model and its wider associated theoretical basis received sharp criticism from the post-processual movement (cf. Chapman 1995); Hodder argued that it was of little use as all human societies and animal species are territorial, and that the approach neglected the symbolic meaning of the tombs themselves in their specific context in an attempt to map general patterns — a passive view of society that disregards ideology (1984: 52–52). Morris sees merit in the Saxe/Goldstein hypothesis, that underlies the territoriality model, but only as one of many possible methodologies, and while asserting that it should be applied with due regard to human agency as it could well be subverted by other messages that the buriers were trying to convey (1991: 147, 163). Modern applications of the territoriality model are employed much more broadly than the largely ecological angle adopted in the past, incorporating more contemporary areas of research including ideology, power, emotion and inequality, and stress that territoriality may employ other means of expression than the traditional material culture of markers (cf. Zedeño 2008). They often employ territoriality as one of multiple overlapping means of interpreting the behaviour and material culture of past societies (e.g. Mantha 2009).

The territoriality model has been applied widely in the interpretation of the prehistoric funerary archaeology of Arabia. Wilkinson suggests that cairn fields from across the region represent the remains of nomadic pastoralists emphasising their status and proclaiming their ownership of territory (2003: 180–181). Working in Dhofar and Hadramawt the RASA-AHSD project repeatedly employ territoriality, amongst other models, to explore the distribution of High Circular Tombs and other monuments (Harrower, Senn, et al. 2014; McCorriston 2013; McCorriston, Steimer-Herbet, et al. 2011; Harrower 2008). Within the context of the northern Oman Peninsula, territoriality underpins Cleuziou's analysis of Hafit tombs; he argues that tombs were deliberately constructed in order to mark rights of access to resources including newly created arable farms, fishing grounds and beaches, grazing pasture, as well as territorial borders and the approach to settlements (Cleuziou 1997: 407; 2002b: 196–201; 2007b: 211–213). The present author has argued that the marking of ownership of land was important because the nomadic Hafit population could not be present in every part of their range to defend it (Deadman 2012a: 33), and al-Jahwari has highlighted the fact that seasonal resources were frequently marked by Hafit tombs (2013a: 151). Others have develop applied the model in a more sophisticated fashion as part of their interpretation, asserting that as well as marking access rights and territories (Giraud 2009: 748; Cable 2012: 204–206), Hafit tombs also established a landscape of identity by defining the living space of the tomb builders (Giraud 2010: 79, 83), and that their construction provided a ritual and physical means of social integration (Cable 2012: 204–206).

Hafit expressions of territoriality in the Batinah are very similar to those already observed elsewhere in the northern Oman Peninsula. GIS analysis of the Batinah survey results revealed that Hafit tombs are situated in areas with at least some high ground, and were usually constructed in areas that are elevated above the majority of the surrounding landscape (Chapter 5.4.3). Tomb visibility was augmented at some sites through the choice of contrasting building materials, or building material and the local geology: darkly patinated wadi cobbles and pale buff, angular Tertiary bedrock (Figure 8.13). Evidence for tomb reuse or later remodelling was frequently observed during fieldwork, demonstrating their significance as powerful monuments within the landscape.

Figure 8.13: Hafit territoriality in the Batinah — elevated tomb placement and use of contrasting materials

8.3.3 Socio-political organisation

The distribution of Hafit tombs strongly suggests that the northern Oman Peninsula was divided into territories, but the socio-political organisation of these local Hafit populations is less clear. The sizeable surface area and the small Hafit population within each territory suggest that they were nomadic pastoralists. Therefore, the likely social structure of the population consists of large, related groups controlling their own territory, divided into individual extended family groups that moved around this shared land independently. This is the standard socio-political model of nomadic pastoralist populations in the northern Oman Peninsula, although directly comparable ethnographic examples of independent pastoralists simply do not exist in the modern world (McCorriston, Harrower, Martin, et al. 2012: 46). The Harasiis are a tribe of ~2,000 camel and goat herders that traditionally occupied a huge territory — the barren Jiddat plateau in the south of the Omani central desert — and migrate as independent household groups made up of individual extended families (Chatty 1996; 1990: 341). Traditionally in Ras al-Khaimah territory was tribally owned, but individual or small groups of families would move around grazing areas independently (Lancaster and Lancaster 2011: 26–34). In Ja'alan herders move out from wadis with permanent water as soon as seasonal water becomes available, and each family heads to one of five or six favoured areas in peripheral parts of their overall territory in order to avoid overgrazing and allow water sources to replenish (Lancaster and Lancaster 2002: 243). Cleuziou has developed a model of the socio-political organisation of Hafit society: an egalitarian society organised around kinship at the three levels of the nuclear family, the extended family, and the tribe — a precursor to the modern Arabian tribal system. He suggests that the nuclear family would share a tomb and a dwelling, the extended family would share a cluster of tombs and dwellings, and the tribe would share the same cemetery, settlement and territory (Cleuziou and Tosi 2007: 94–96, 121–122; Cleuziou 2007b; 2003; 2002b; 1997). There is very little evidence available to test this largely speculative model of Hafit society, and it is probably unwise to extrapolate backwards over such long periods of time to make such assumptions about the prevailing nature of Arabian social structures. Very little research has been carried out on human remains from Hafit tombs, but the demographics of those interred in the later tombs investigated around Dhank add weight to the suggestion that they were used by nuclear families (Williams and Gregoricka 2013: 147).

8.3.4 A shared and regionalised ideology

Similarities in the architecture and distribution of Hafit tombs across the northern Oman Peninsula suggest that the Hafit population as a whole shared a common socio-political structure and an ideology and belief system. The results of the NOP-GE survey show general consistency in tomb distribution across the northern Oman Peninsula (Chapter 4.6), and tomb architecture and furnishings are also largely consistent (Chapter 1.1.2). This provides circumstantial evidence of a common socio-political structure and ideology across the region. The large numbers of tombs observed in the Batinah during fieldwork suggest that interment in Hafit tombs was open to all members of society and not restricted to an elite (Chapter 5.3.3). There is general agreement in the literature for an egalitarian Hafit socio-political model organised around kinship (Chapter 2). Cleuziou has argued that the collective nature of Hafit tombs signifies an equality in the treatment of the dead and that kinship was the major factor in the Hafit social system (Cleuziou 2002b: 202; Cleuziou and Tosi 2007: 122). The sparse osteoarchaeological research suggests that both sexes and all ages were interred in the same tomb (Williams and Gregoricka 2013: 147; Salvatori 2001: 69–71). In Hafit collective burial bones become disarticulated and mixed over time (Chapter 1.1.2) — or even deliberately rearranged (Salvatori 2001: 69) — suggesting that the community was of greater significance than the individual. The few well preserved individuals excavated in Hafit tombs were interred with a modest array of individual goods including pottery, jewellery and tools or weapons (Chapter 1.1.2) — the value of furnishings does not obviously vary to any great extent between individuals, suggesting that at least in death they were treated in a similar way by the community. Cable has argued that as well as revealing the social equality of Hafit society, tombs provided a means of reinforcing it through their construction — the simple architecture allowed all members of the community to be involved in the building of the tombs in which they would later be interred (Cable 2012: 205–206). Similarly, Giraud has argued that the deliberate placement of tombs in visible positions was as much about defining a living space for the local population as warning off outsiders — establishing a 'landscape of identity' that connected individuals to the land, their ancestors and each other (Giraud 2010: 79, 83).

However, subtle differences in tomb architecture may reveal some variation in ideological beliefs between different parts of the northern Oman Peninsula. Fieldwork data from Batinah tombs uncovered differences in the orientation of tomb entrances within the region (Chapter 5.3.2, 6). At Halban — in the southeast of the Batinah — all of the visible tomb entrances point east-southeast, towards the winter sunrise, while at Wadi al-Hoqain, al-Hamid and two other groundtruthing sites (H-19 and H-21) — in the centre and northwest of the region — tomb entrances point in every other direction from southeast to north. This reflects Hafit tomb entrances across the northern Oman Peninsula (Figure 8.14) — there is an east-west divide: tombs in the east reflect the annual variation in the direction of the sunrise; while those in the west show no obvious astronomical relationship. This may suggest that despite the largely uniform material culture, variations in ideology and belief systems may have existed between Hafit populations in different regions (Deadman 2014: 147–148). Such ideological diversity may have manifested itself in the architecture of the apparently later Hafit tombs (Chapter 1.1.2) — 'transitional' tombs do not form a single type, and there is a substantial variation between the 'beehive' tombs at Bat (Böhme 2011), the 'tower' tombs at Shir/Jaylah (Yule and Weisgerber 1998), the large double-chambered tomb at Kalba (Eddisford and Phillips 2009), and the small four-chambered tombs at Jabal Emalah and Jabal Buhais (Benton and Potts 1994; Jasim 2012).

8.3.5 Social change

The archaeological evidence hints at socio-political change in Hafit society over the course of the period. Findings from the three cemeteries surveyed in detail suggest that Hafit funerary architecture developed over time — tombs were distributed more densely and at a lower position in the landscape, their size increased, the outer wall facing became more elaborate, and the quality of the construction generally appears to have increased (Chapter 6.5). At Halban, Hafit tombs slowly developed into Umm an-Nar tombs, with two early examples of these funerary structures being present at the site. Tombs from these three sites contrast sharply with the small and simple structures common throughout the Batinah (Chapter 5.2.2, 5.3.2). Developments in the political organisation of Hafit society may have run parallel to these changes in the funerary architecture. Without excavating it is impossible to establish the relative chronology of tomb construction and use at the three sites, so interpretation of the evidence is conjectural. If multiple tombs of varying size and build-quality were in use at the same time at the same site than this may suggest the emergence of stratification in Hafit society — with an individual's status or the wealth and power of their family dictating the tomb in which they were interred (Deadman, Kennet, et al. 2015). This jars with the

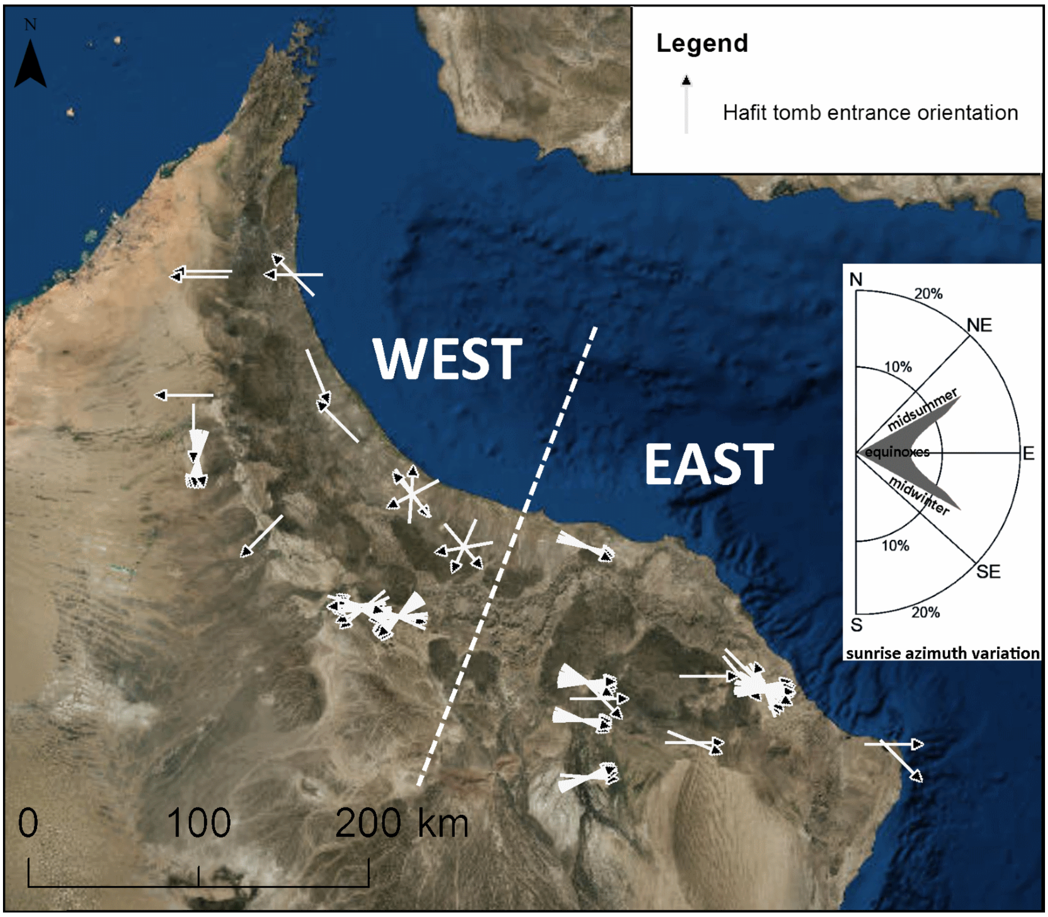


Figure 8.14: Variation in the orientation of Hafit tomb entrances in the northern Oman peninsula, based on fieldwork and literature (Appendix D)

unanimously accepted egalitarian model of Hafit society (Chapter 2). Alternatively, if only one or two similar tombs were in use at the same time at these Hafit sites, than the changes in the funerary architecture may reflect the growing skills and wealth of the group as a whole and the galvanisation of the egalitarian social structure in response to economic change. Developments in Hafit funerary architecture are apparent in the archaeological record across the northern Oman Peninsula — from small, single-walled structures lacking doors, to larger, well-constructed, doored tombs with three or four ringwalls, to 'transitional' structures with multiple chambers, sophisticated facing, paving and plinths (Chapter 1.1.2) — these changes may also reflect developments in the Hafit social structure. In Dhank *wilaya*, observations made by the SoBO team following the excavation of a number of Hafit tombs supported by a radiocarbon chronology reveal that later Hafit tombs are larger and boast a better quality of construction compared to earlier structures, as well as the adoption of collective burial practices with only single interments being observed in early tombs (Williams and Gregoricka 2013: 146–147). Rouse and Weeks' agent-based modelling highlights the potential for the emergent technologies and specialisations to increase socio-economic inequality in Hafit society with wealth and resources unequally distributed throughout the population; they argue that the introduction of collective burial was an ideological response to this destabilising disparity that strengthened the social egalitarianism of Hafit society (2011).

8.4 Conclusion

Despite a lengthy history of research into the Hafit archaeological dataset in Oman and the U.A.E., relatively little has been written on Hafit society itself. There is currently little consensus on even the most fundamental aspects of Hafit subsistence, economy and socio-political organisation. The ultimate aim of this thesis is to shed light on the nature of Hafit society in the Batinah and more widely in the northern Oman Peninsula. This chapter brings together the material and analysis presented in previous chapters with the published literature in an attempt to establish a current overview of what is currently known about Hafit society. This is discussed under three headings: subsistence; the wider economy; and politics and ideology. The chapter argues that nomadic pastoralism rather than sedentary agriculture was central to Hafit society, and that this was supplemented with food harvested by the coast in Ja'alan and the Batinah. The movements of the Hafit population may have been partially governed by the seasons. There is some evidence for the decreasing mobility, a gradual sedentarisation, of the Hafit population in the latter stages of the period. Copper was central to the Hafit economy and partially dictated Hafit settlement, especially on the Batinah. Lively local exchange produced the uniform Hafit material culture, and international trade with Mesopotamia and other regional powers was likely important. Significant new skills and specialisations emerged and developed over the course of the period. Politically, the landscape of the northern Oman Peninsula was divided into territories, often centred around major wadi basins in much of the region and around Tertiary outcrops in the Batinah; all were reinforced through the construction of tombs in visible positions. As nomadic pastoralists each territory is likely to have supported a significant number of extended family groups that moved around independently, connected through a kinship bond. The entire region is likely to have shared a common ideology and egalitarian socio-political structure. There is some evidence for social change over the course of the Hafit period, especially in the Batinah, possibly with the emergence of an elite benefiting from the copper trade, but more likely with a galvanised reinforcement of the original egalitarian structure with the initiation of collective burial. The imperfect accuracy of the

Google Earth-based methods demands that some of these conclusions drawn from such data should be tempered with a note of caution, and as our understanding of the region's funerary archaeology advances both may need to be revised and updated (Chapter 4.2).

This attempt to understand Hafit society better has made significant progress, but a huge amount remains to be done before we can claim to have a thorough understanding of how the population of the northern Oman Peninsula lived during the late fourth and early third millennia BC. Questions also remain as to how Hafit archaeology and society fits into the wider regional context, this will be explored in the next chapter.

Chapter 9

The wider regional context: fourth and third millennia BC stone tombs in Southwest Asia

Although research into the Hafit material culture is significant in its own right, it also forms part of a much larger story of the Neolithic and Early Bronze Age in the Middle and Near East. The sudden appearance and prevalence of Hafit tombs is only one element of a wider phenomenon of the construction of stone tombs in Southwest Asia in the fourth and third millennia BC. Rather than seeking a universal explanation for this regional trend, the primary reason for exploring this phenomenon is to draw comparisons between Hafit tombs and similar funerary datasets in the Near and Middle East, in the hope of shedding light on the nature of Bronze Age society in the northern Oman Peninsula and further afield. In addition, the northern Oman Peninsula has much to add to the discussion of Neolithic/Bronze Age themes in the Near and Middle East, bringing the many strengths and insights of the Hafit dataset to bear on subjects such as: Bronze Age trade and exchange; the impact of copper on society; nomadic pastoralism; the adoption of sedentary agriculture; territoriality and the protection of resources; early specialisation and stratification in society; and collective burial and egalitarian societies. Moreover, the Near and Middle East was the likely source of technologies adopted by the population of the northern Oman Peninsula during the Neolithic and Bronze Age including: animal husbandry (Uerpmann et al. 2000); copper metallurgy (Weeks 2003: 36; Cleuziou and Méry 2002: 282); pottery (Potts 2006); arable agriculture, specifically the oasis model (Potts 1994); and, later on, *qanat/falaj* irrigation (Lightfoot 2000). If Hafit tombs, which are so central to our understanding of the period, are yet another import from the wider region, then it is vital to understand where they might have come from, and what this reveals about the nature of Hafit society. This outside influence could be crucial to our understanding of social change and development in the Neolithic and Bronze Age of the northern Oman Peninsula: what did the contact between the Arabian and Levantine communities look like and how did these technologies and ideas spread? The stone tombs may be the clearest example of this transmission.

This subject clearly has a great deal of potential, but with space limited this chapter will explore the stone tomb phenomenon generally, and will examine three case studies from across the region that have the potential to provide insight into the Hafit funerary tradition and Hafit society.

9.1 The Southwest Asia stone tomb phenomenon

Archaeologists have long noted a widespread, 4th and 3rd millennium BC stone tomb building phenomenon covering much of Arabia and Sinai (Steimer-Herbet et al. 2006: 263; Wilkinson 2003: 180; de Maigret 1996: 324; Orchard 1995: 151). Small, drystone, corbelled, tower-shaped tombs have been observed across much of this arid region (Yule and Weisgerber 1998: 205–207; Steimer-Herbet 2001: 221; Harrower 2008: 504; McCorriston, Steimer-Herbet, et al. 2011: 9–10), located on hills, ridges and mountains (Wilkinson 2003: 180). As well as the Hafit tombs in northern Oman and the U.A.E., ‘high circular tombs’ have been reported in Dhofar in southern Oman (McCorriston, Harrower, Steimer, et al. 2014; al-Shahri 1991: 184–185), and in the Jawf-Hadramawt basin in Yemen (de Maigret 1996; Braemer, Buchet, et al. 2001; McCorriston, Steimer-Herbet, et al. 2011), while similar funerary structures are known in the northern, southern, western and eastern provinces of Saudi Arabia (Adams et al. 1977; Potts et al. 1978; Zarins, Ibrahim, et al. 1979; Zarins, Murad, et al. 1981; Ingraham et al. 1981). ‘Nawamis’, remarkably similar to tombs in eastern and southern Arabia, have been recorded in the hilly interior of southern Sinai (Bar-Yosef, Belfer, et al. 1977). Simpler burial cairns have been documented on the eastern Yemeni coast (Rougeulle 1999), in Qatar (de Cardi 1978; Midant-Reynes 1985; Cuttler, al-Naimi, et al. 2013; Lopez, Morabito, et al. 2015), and Kuwait (Carter et al. 1999; Rutkowski 2011: 10–23; 2014), as well as more impressive tumuli in Bahrain (Ibrahim 1982; Mughal 1983; Højlund 2007; Laursen 2008). Moreover, burial cairns have been reported on the other side of the Persian/Arabian Gulf in Southern Iran and Baluchistan (Mockler 1877; Hughes-Buller 1907; Stein 1929; 1931; 1935; 1937; Lamberg-Karlovsky and Humphries 1968; Gupta 1972: 125–145; Azarpay 1981).

A similarly widespread distribution of stone tombs occurs in the Levant, which has been described as the ‘megalithic phenomenon’ due to the common inclusion of large stone blocks in the funerary structures (Zohar 1992; Scheltema 2008; Polcaro 2013).

Dolmens, architecturally diverse, are the main focus of this Levantine phenomenon (Epstein 1985; Zohar 1992; Prag 1995), but other stone-built structures such as cairns/tumuli, standing stones, and tower tombs are also included (Bradbury 2011; Scheltema 2008; Steimer-Herbet 2004). Very few of these features have been securely dated, but the available evidence suggests that many may be attributed to the fourth and third millennia BC — the Late Chalcolithic and Early Bronze period — which seem to mark the start of the tradition (Polcaro 2013: 127; Bradbury and Philip 2011: 172; Prag 1995: 78; Zohar 1992: 51–52). The form and distribution of these diverse structures varies across the Levant: tower tombs, dolmens and/or burial cairns have been reported in the Negev (Avner 1997; Steimer-Herbet 2004: 130; Haiman 1992); southern and southeastern Jordan (Scheltema 2008; Abu-Azizeh et al. 2014); on either side of the Jordan Valley (Epstein 1985; Fraser 2015); in the more arid areas of central and eastern Jordan (Field 1960; Betts 1993); southern Syria (Beaulieu 1945; Braemer, Echallier, et al. 2004; Nasrallah 1950); Lebanon (Tallon 1958); and central and northwestern Syria (Masuda 1986; Bradbury 2011).

The distribution of fourth and third millennia BC stone tombs covers a huge area of Southwest Asia — over 2,000 km from north to south and east to west (Figure 9.1). Zohar argues that the Levantine and Arabian stone tomb phenomena represent two separate traditions — a megalithic and a tumulus tradition, with the former occupying a discrete area of the Levant independent of other known occurrences in northern Africa or the Caucus (1992: 51–53). This is typical of the literature as a whole — Arabian and Levantine tombs are usually discussed in the context of the local region. Others discuss the distribution of a single monument type over both areas — dolmens or tower tombs — but ignore the other structures (Scheltema 2008: 18; Orchard and Orchard 2007: 148, plate 17). However, Steimer-Herbert argues that all fourth and third millennium BC stone tombs in the Arabian Peninsula, the Sinai Peninsula and the Levant represent a single phenomenon, replacing the Levantine megalithic label with *"sépultures à superstructure lithique"* as a more inclusive term (Steimer-Herbet 1999: 181; 2004: 6, 12–13).

While this extensive distribution of stone tombs is intriguing, it should be noted that strong dating evidence attributing them to the 4th and 3rd millennia BC is lacking in some cases, and confused by later re-use and rebuilding, while often a date in this period is assumed based on loose typological similarities with monuments in neighbouring regions. In Arabia, imported Mesopotamian Early Dynastic pottery dates some of the stone graves in Saudi Arabia (Potts 1990b: 64; Burkholder 1974: 162), but many have not been excavated and so a 4th and 3rd millennium BC date is assumed (Steimer-Herbet 2004: 6, 70–85). While radiocarbon dates place the initial use of Jawf-Hadramawt tombs to the 4th and 3rd millennia BC, they were also reused later on in the Iron Age which

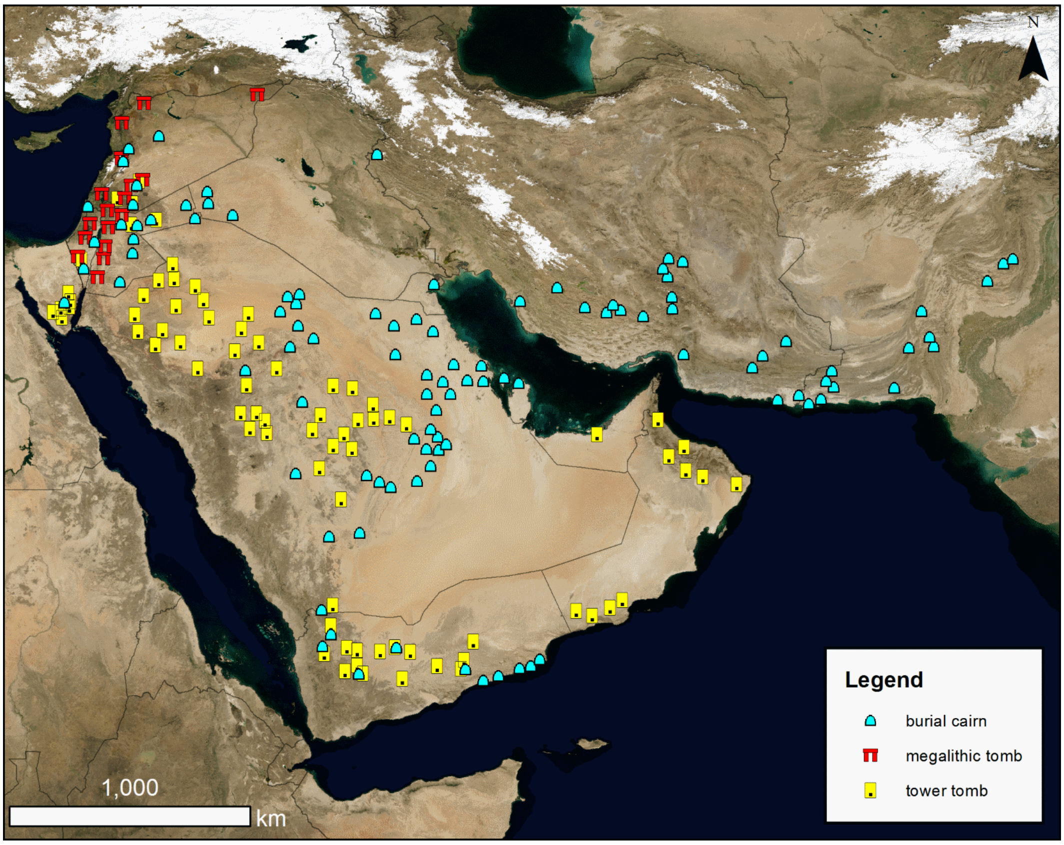


Figure 9.1: The distribution of burial cairns, megalithic tombs and tower tombs in Southwest Asia (data simplified from Steimer-Herbet 2004: maps 1–9; Bradbury 2011: 3.17, 3.18; Fraser 2015: figures 5.1, 6.1; de Maigret 1996: figure 13; Goren 1980: figure 6; Lamberg-Karlovsky and Humphries 1968: figure 3; McCorriston, Harrower, Steimer, et al. 2014: plate 1)

confuses matters (Braemer, Buchet, et al. 2001: 40–41; de Maigret 2002: 331; McCorriston, Steimer-Herbet, et al. 2011: 11), and the coastal cairns are yet to be dated accurately (Rougeulle 1999: 123). Dating evidence for the use of the Kuwaiti cairns ranges between the Neolithic and the second millennium BC, and it is not known if any were constructed during the 4th and 3rd millennia (Rutkowski 2011: 22–23). On the other side of the Arabian/Persian Gulf, the somewhat meagre dating evidence places some of the cairns to the 1st millennium BC — especially in Baluchistan (de Cardi 1951; Gordon 1955; Lamberg-Karlovsky and Humphries 1968; Gupta 1972: 125–145; Azarpay 1981) — but dating evidence is entirely lacking for much of this huge expanse. In the Levant the dating evidence is a little clearer, with well preserved funerary assemblages dating the use of megalithic tombs between the Late Chalcolithic and the EB IV, possibly even into the MBA (Fraser 2015: 42–42). There is also some evidence that the tradition may have first originated in the ceramic Neolithic in the sixth millennium BC (Abu-Azizeh et al. 2014; Iamoni 2014; Morandi-Bonazcossi and Iamoni 2012). Surface pickups of pottery and lithic material in and around large numbers of cairns in the Homs area suggest that the main phases of their construction were in the Chalcolithic/Early Bronze Age and in the Hellenstic/Roman period (Bradbury 2011: 229–236). Pottery and lithic finds in some cairn fields in the Negev date the structures to the Early Bronze Age, while others may stretch into the Middle Bronze Age (Haiman 1993: 58–59; 1992: 25–26). Despite widespread looting and later reuse, flint, copper, pottery and bead finds from southern Sinai tombs are consistent with a Chalcolithic to Early Bronze I date (Bar-Yosef, Belfer-Cohen, et al. 1986: 164–165; Bar-Yosef, Belfer, et al. 1977: 86–88). While the dating of the stone tombs is far from clear cut in some cases, what concrete evidence there is does point to the widespread initial adoption of the burial tradition in the 4th and 3rd millennia BC, although undoubtedly in some cases it started earlier and continued in some form across the region, off and on, until the coming of Islam and Islamic burial traditions.

Unsurprisingly, there is a great deal of variation in the form of these stone tombs and many typologies have been constructed to compare them (Steimer-Herbet 2004; Zohar 1992; Epstein 1985), while on the other hand clear architectural differences have been ignored in order to inclusively and neatly classify tomb types (Fraser 2015: 39). At the very broadest level — putting aside their significant diversity — there are three main classes of stone tomb that are the most widely and densely distributed across Southwest Asia. Cairns (or tumuli) are piles of stone and/or earth that cover a subterranean cist or an above-ground stone chamber; megalithic tombs (or 'dolmens') are funerary structures built with large stone blocks, but often also using smaller stones and/or soil; and tower tombs are corbelled, drystone funerary structures that are usually circular or, more rarely, square.

The scale of the phenomenon makes interpretation difficult. The emergence of the tombs in the Levant is concomitant with a number of social and economic developments including the emergence of complex society, regionalised pottery traditions and increased intensification and specialisation of local economies, suggesting that the structures may have formed part of a response to a phase of significant change in the region (Bradbury 2011: 489). Some have interpreted the megalithic phenomenon as the result of competitive pressures between nomadic and sedentary communities in marginal zones, a means of establishing a territorial claim with monuments that combined the funerary traditions of both populations (Prag 1995: 98; Zohar 1992: 54–55). The phenomenon is often cited as evidence of the existence of a shared 'culture' across the southern Levant — either of a nomadic pastoralist lifestyle, traditions or kinship — with the presence of megalithic tombs demonstrating overall commonality, and local variations the result of differences in local tribal custom (Zohar 1992: 44; Epstein 1985: 57). Relatively little has been published discussing the Arabian stone tomb phenomenon, but broadly similar interpretations are made: a 'culture' of peculiar funeral rites originating in the fourth millennium BC and native to the sub-continent (de Maigret 1996: 335). Wilkinson suggests that the tombs reveal a common subsistence strategy and concern — local populations of mobile pastoralists emphasising ownership of territory and resources in the arid lands on the desert periphery (2003: 180–181). Others have asserted some shared aspects of socio-political organisation and ideology — that the tombs tell and reinforce lineage narratives in establishing territorial rights of the local groups (McCorriston, Steimer-Herbet, et al. 2011: 9–10). The Orchards go much further and argue that the architectural similarities of Arabian tower tombs demonstrate the existence of beliefs and rituals that were common to the region as a whole, with local variations the result of tribal differences (Orchard and Orchard 2007: 148). Linking the two areas, Newton and Zarins have argued for the existence of an Arabian megalithic Bronze Age complex of local populations that were similar in character and which had established links to the southern Levant (Newton and Zarins 2000: 167). Going further, Steimer-Herbert links the stone tombs of Levant and Arabia, arguing that while they were not built by the same builders, the populations of both areas came from the same cultural context, from a climatically and geologically similar semi-desert environment, and that all of the tombs are the work of nomadic or semi-nomadic pastoralists (Steimer-Herbet 2004: 6, 29–31; 1999: 181).

However, a number of objections to the megalithic/stone tomb phenomenon have been raised. "There is a limited number of ways, especially within stony landscapes, to bury human remains" (Bradbury 2011: 170), and it is possible to over-emphasise the similarities between stone tombs that are separated by great distances. Moreover, it may be unwise to overstate the uniformity of such widespread burial traditions in the hope of making simplistic, generalised interpretations as to the economy and society of stone tomb building populations. Philip (2008: 35) has highlighted the difficulties involved in ascribing certain funerary traditions to certain communities — specifically the traditional association of shaft tombs with sedentary groups and dolmens with pastoralists in Early Bronze Age Jordan, suggesting that local archaeological context is more important in interpretation than broad, supra-regional trends. Fraser has challenged the view that dolmens represent part of a Levantine megalithic phenomenon, arguing that a historical fascination with such monuments has influenced interpretations in ways that the data do not support (2015: 1). In his study of the distribution of true, trilithon dolmens in the southern Levant, he asserts that studies adopting a broader perspective have ignored differences in form, chronology and distribution in order to subsume monuments within a vaguely defined megalithic phenomenon, and that monuments should be approached contextually as local mortuary traditions rather than generalised in order to conform to a broad regional trend (Fraser 2015: 39, 1). Clearly the stone tomb phenomenon is a fascinating feature of fourth and third millennia BC archaeology in the region, but there are significant dangers in glibly making generalised interpretations regarding past societies covering such an enormous area without clear evidence.

9.2 Case studies: Yemen, southern Sinai and western Syria

As stated, the stone tomb phenomenon may further the study of the Hafit funerary dataset by providing a body of comparative material — contemporary populations responding to similar challenges in a similar environment — as well as evidence for the role of external stimuli in the development of Hafit society; moreover, the Hafit period has much to add to the broader thematic discussions of Neolithic and Bronze Age societies in the Near and Middle East. As it will obviously not be possible to explore these subjects to their full potential in this chapter, three case studies will be examined from the far corners of the stone tomb distribution: Yemen, Sinai and western Syria. The architecture, distribution and furnishings of the tombs in these areas will be examined, before exploring what light they may shed on the Hafit funerary dataset and Hafit society.

9.2.1 High circular tombs in the Jawf-Hadramawt basin, Yemen

The high circular tombs (HCTs) of Yemen — also known as pill-box tombs, turret graves, and tower tombs — were first described in the reports of early 20th century travellers (Ingrams 1936: 538; Philby 1939: 367–379; Stark 1939: 3, 7; Ingrams 1941: 124). Their descriptions were included in early archaeological and historical studies of Yemen (Bowen 1958: 133–137; Groom 1981: 224–225; Doe 1983: 54–62). The first modern archaeological surveys were carried out by French and Italian teams that discovered more tomb sites in the Jawf-Hadramawt basin, and also conducted the first excavations (Cleuziou, Inizan, and Robin 1988; Cleuziou, Inizan, and Marcolongo 1992; Vogt and Sedov 1993; de Maigret 1996). Modern archaeological research investigating the tombs has been curtailed by unrest and civil war in Yemen (Steimer-Herbet 1999; 2001; Braemer, Buchet, et al. 2001; Steimer-Herbet et al. 2006; Crassard and Hitgen 2007; McCorriston, Steimer-Herbet, et al. 2011; Harrower, Schuetter, et al. 2013).

The HCTs are drystone tombs resembling small circular turrets or towers with a slightly conical profile (Figure 9.2), constructed of unworked slabs or blocks of local stone on bedrock or a rocky surface (McCorriston, Steimer-Herbet, et al. 2011: 9–10; Steimer-Herbet et al. 2006: 262; de Maigret 1996: 324). At the base they range in diameter from three to ten metres — three to five metres is more typical — and may reach two to three metres in height (Crassard and Hitgen 2007: 45; Braemer, Buchet, et al. 2001: 29; Doe 1983: 54). Tomb walls are usually ~1m thick and consist of an outer and an inner face with a rubble fill between (McCorriston, Steimer-Herbet, et al. 2011: 10; Steimer-Herbet et al. 2006: 262; de Maigret 2002: 329). They encompass a single circular or sub-circular chamber, one to two metres in diameter and defined by a ring of upright slabs; the inner wall is corbelled inwards with the resulting hole capped with slabs to form a flat roof (Crassard and Hitgen 2007: 45; Braemer, Buchet, et al. 2001: 29; Doe 1983: 54; de Maigret 1996: 324). Some tombs have entrances, square or trapezoidal in shape and usually blocked with stones, set a metre above the base of the floor and facing westwards — from southwest to northwest, corresponding to variation in the direction of sunrise throughout the year (Braemer, Buchet, et al. 2001: 29–30; de Maigret 2002: 329; Doe 1983: 54). Others lack entrances and may have been accessed through the roof (McCorriston, Steimer-Herbet, et al. 2011: 13; Steimer-Herbet et al. 2006: 262). Many HCTs have 'tails' of low walls or stone piles that extend out radially from the tomb up to 100m (Crassard and Hitgen 2007: 46; Steimer-Herbet 2001: 221; de Maigret 1996: 324; Cleuziou, Inizan, and Marcolongo 1992: 22). At some sites multiple tombs are conjoined in groups of two to six, each with an independent chamber and entrance (Braemer, Buchet, et al. 2001: 29; Steimer-Herbet 2001: 221), and a minority have 'standing stones' incorporated into the roof structure (Steimer-Herbet 1999: 180). The preservation of the tombs varies depending on the quality of the original construction, the suitability of the building materials, the slope and the extent of looting and stone-robbing, and can sometimes confuse the original architecture and mislead classification during survey (McCorriston, Steimer-Herbet, et al. 2011: 10; Crassard and Hitgen 2007: 45).

HCTs are found on high ground throughout much of the Wadi al-Jawf and Wadi Hadramawt basins (Figure 9.3) which are separated by the barren depression of Ramlat as-Sabat'ayn (McCorriston, Steimer-Herbet, et al. 2011: 1; de Maigret 1996: 324; Cleuziou, Inizan, and Marcolongo 1992: 5). In the west they have been reported across large parts of the Jawf: in the northern hills around Jebel Khalan; to the west at 'Arf Sufan (Steimer-Herbet 2001: 221); in uplands further south, between Sana'a and Dhamar (de Maigret 1996: figure 13); and around the fringes of the Ramlat as-Sabat'ayn, including al-Makhdarah to the west (de Maigret and Antonini 2005), Jebel Jidran and Jebel Ruwaik to the north (Braemer, Buchet, et al. 2001), and around Shabwa in the east (Pirenne 1990). Further east they are found in Wadi Hadramawt's smaller tributary basins including Wadis Sana (Harrower 2008: 504–505), Wash'ah (Steimer-Herbet et al. 2006), Harou, Harad and 'Idm (McCorriston, Steimer-Herbet, et al. 2011: 11–12, figure 13). This rugged terrain is hyper-arid — historically able to support only a low density of mobile pastoralist populations rather than the sophisticated

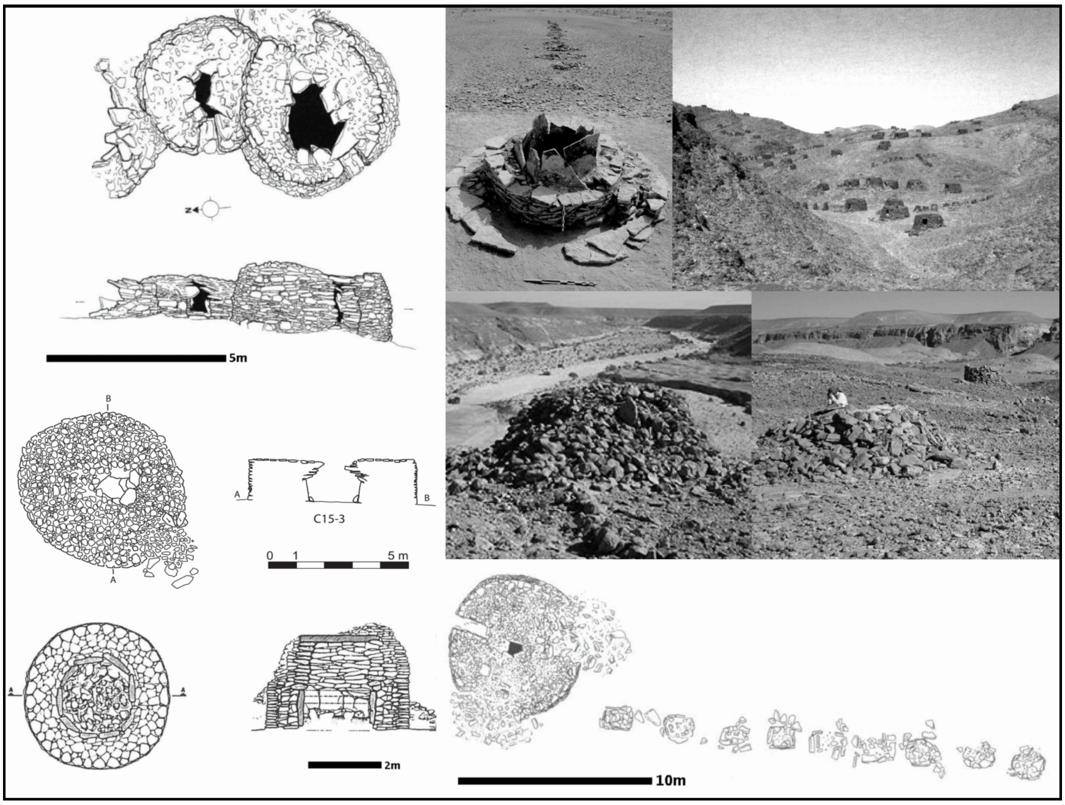


Figure 9.2: Plans and photos of HCTs in Yemen (altered after Braemer, Buchet, et al. 2001: figures 8–10; McCorriston, Steimer-Herbet, et al. 2011: figures 3, 7; de Maigret 1996: figure 3; Crassard and Hitgen 2007: figure 5)

sedentary settlements found elsewhere in South Arabia (Harrower 2008: 498; Ja'afar Bin 'Aqil and McCorriston 2009: 603). Despite their relative overall abundance, HCTs are not evenly distributed across the landscape (Harrower, Schuetter, et al. 2013: 259–260). They are overwhelmingly positioned on highly visible ridges, hills and terraces, constructed of the same local rock on which they are built (McCorriston, Harrower, Martin, et al. 2012: 50; Cleuziou, Inizan, and Marcolongo 1992: 22; de Maigret 2002: 329), and usually overlook wadi channels (Schuetter et al. 2013: 6613; Steimer-Herbet et al. 2006: 262; Doe 1983: 59). They are found either alone/in small groups, or aggregated in huge numbers in large graveyards (de Maigret 1996: 324): in Wadi Wash'ah 82 groups of tombs — lone monuments or clusters of three to six structures — stretch along the 35km length of the wadi (Steimer-Herbet et al. 2006: 261–263); while at Jebel Jidran and Jebel Ruwaik on the northern edge of the Ramlat Sabat'ayn, several thousand tombs are packed together in a relatively small area (Steimer-Herbet 2001; 1999; de Maigret 2002: 337). In larger graveyards they are sometimes distributed in long, parallel lines running along ridges (Philby 1939: 371–373; Braemer, Buchet, et al. 2001: 24–26), or in less organised, organic clusters (Braemer, Buchet, et al. 2001: 27). A contrast with the conspicuous tombs, even large graveyards are not associated with clear settlement remains (Braemer, Buchet, et al. 2001: 41–42), but more ephemeral evidence of temporary camps is sometimes found in their immediate environs as in Wadi Wash'ah (Steimer-Herbet et al. 2006: 257), and Wadi Sana (Harrower 2008: 499, 504).

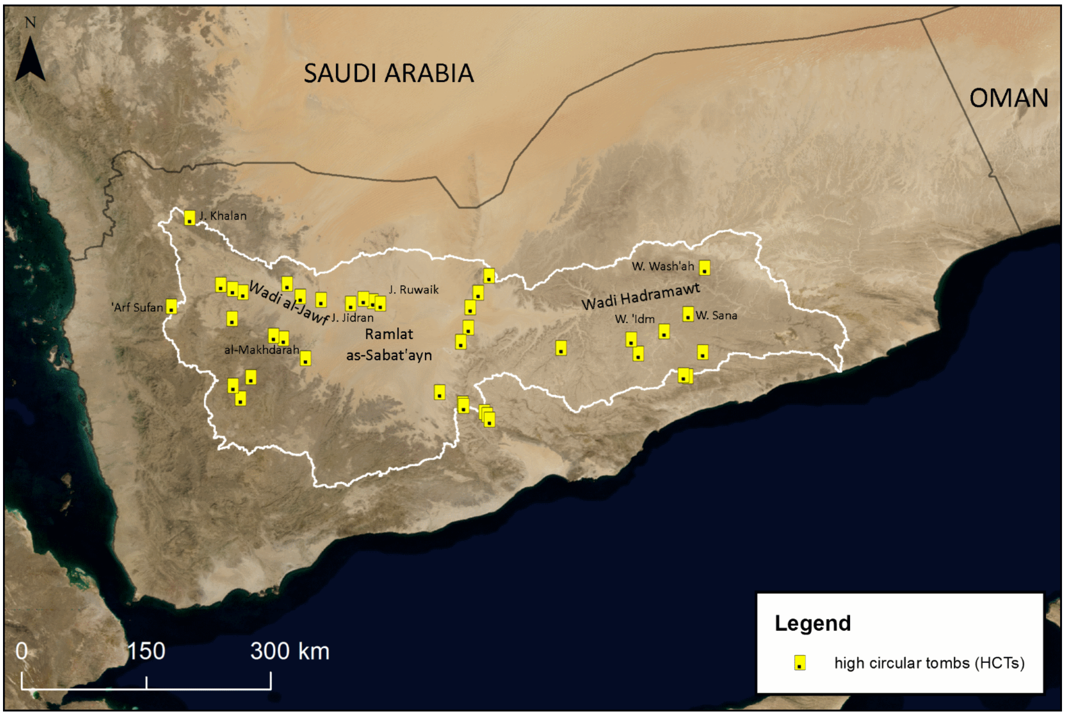


Figure 9.3: The distribution of HCT sites in the Jawf-Hadramawt basin, Yemen

Relatively few HCTs have been excavated, and it is difficult to be sure of what was originally interred because of widespread looting and later reuse (de Maigret 1996: 324; Steimer-Herbet 2001: 223; McCorriston, Steimer-Herbet, et al. 2011: 10). Radiocarbon dates of human bone from the tombs have generated dates from the fourth and third millennia BC, the second and first millennia BC, and a combination of both in the same structure (Braemer, Buchet, et al. 2001: 40–41; de Maigret 2002: 331; McCorriston, Steimer-Herbet, et al. 2011: 11). This suggests that HCTs were built and first used in the fourth and third millennia BC and then reused in later prehistory (Schuetter et al. 2013: 6612–6613). Although it is difficult to be sure because of the disturbance, HCTs appear to have been multiple-successive burials originally, with a small number of individuals interred within each (Steimer-Herbet 2001: 223-224). Additional space was made for further interments by the careful rearrangement of old bones, sometimes in pottery vessels, and new individuals were interred in a supine position with a north-south orientation (Braemer, Buchet, et al. 2001: 32–33). Both sexes, and adults and children were interred in the same tombs; the human remains show indications of intense muscular activity and of walking on difficult terrain, and the dental profile reveals some ante-mortem tooth loss but little decay and few caries (Steimer-Herbet 2001: 223–224; Braemer, Buchet, et al. 2001: 37–39). Grave goods vary between sites (Figure 9.4), but include: low-quality handmade pottery; caprid bones; beads of carnelian, soft-stone and baked material; simple bronze needles and awls; and occasionally chert flakes (McCorriston, Steimer-Herbet, et al. 2011: 12–13; Braemer, Buchet, et al. 2001: 34–35). The carnelian beads are comparable to examples excavated from megalithic tombs in the Levant, and the frit beads have clear parallels to those common in Hafit tombs (Steimer-Herbet 2001: 224).

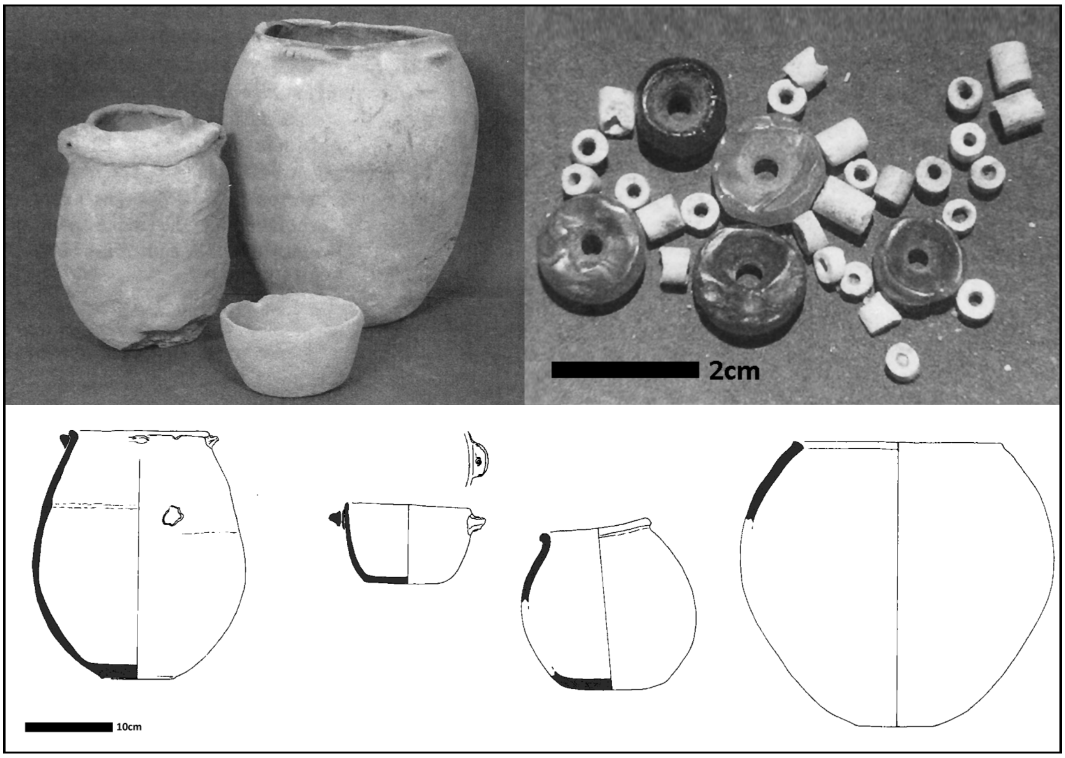


Figure 9.4: Grave goods recovered from HCTs (altered after Steimer-Herbet 2001: figures 6, 7; Braemer, Buchet, et al. 2001: figure 14)

There is unanimous agreement that the original Early Bronze Age builders of the HCTs were nomadic or semi-sedentary pastoralists (McCorriston, Steimer-Herbet, et al. 2011: 14; Harrower, Schuetter, et al. 2013: 264; Steimer-Herbet et al. 2006: 264; Braemer, Buchet, et al. 2001: 21). The environmental conditions of the Jawf-Hadramawt basin would have made sedentism impossible — sedentary Bronze Age societies are found in other parts of South Arabia (McCorriston, Harrower, Martin, et al. 2012: 45–46; Ja'afar Bin 'Aqil and McCorriston 2009: 603–604). The population would have lived in small, temporary camps, the remains of which have been recorded, while larger settlements are entirely absent (Steimer-Herbet et al. 2006; Harrower 2008: 499; Steimer-Herbet 2001: 226). The society is likely to have been seasonally nomadic — this is supported by tomb entrance orientation data — and may have grown winter crops in areas suitable for runoff agriculture (McCorriston, Harrower, Martin, et al. 2012: 50; Harrower 2008: 504; Braemer, Buchet, et al. 2001: 30). This may have been a significant transition phase in South Arabian society from nomadic pastoralism to agro-pastoralism, and later to ancient states (Schuetter et al. 2013: 6611; Harrower 2008). The highly visible HCTs are thought to have proclaimed territorial ownership of strategic resources including pasture, water and runoff farmland (McCorriston, Steimer-Herbet, et al. 2011: 18; Steimer-Herbet et al. 2006: 263–264). The larger, dense cemeteries may have acted as meeting places for periodical ritual gatherings in which the dead were interred (Steimer-Herbet et al. 2006: 263; Steimer-Herbet 1999: 182; Braemer, Buchet, et al. 2001: 41–42). Society is thought to have been organised around kinship, with lineage and ancestors an important focus of group identity, with the tombs helping to preserve cohesion in a dispersed group — this may form the origins of the Arabian tribal system in Yemen (Harrower, Schuetter, et al. 2013: 260; McCorriston, Steimer-Herbet, et al. 2011: 14, 18; McCorriston, Harrower, Martin, et al. 2012: 45), although this is almost purely speculative.

9.2.2 Nawamis in southern Sinai

The nawamis tombs of southern Sinai were first recorded by an Ordnance Survey team mapping the Sinai Peninsula, supported by the newly-established Palestine Exploration Fund (Wilson et al. 1869; Palmer 1871). The surveyors mistook the structures for small houses (Holland 1870: 18–19; 1871: 543–544), and recorded that their name — a broken plural of 'mosquito' in Arabic — originated from a Bedouin legend of Israelites building shelters from insects during the Exodus (Wilson et al. 1869: 194). They were first excavated by Petrie and Currelly during their Sinai Expedition (Currelly 1906); the findings of the original OS survey were re-evaluated shortly afterwards (Peet 1915). They were noted very briefly in a report of the University of California's Expedition to the Sinai in 1947 (Albright 1948: 17). The only recent archaeological research examining the tombs resulted from Israel's occupation of the Sinai in 1967: with the Arabah Expedition's survey of the Sinai discovering new nawamis sites (Rothenberg 1970: 21; 1972: 36–37; Goren 1980). New excavations were carried out at two sites (Bar-Yosef, Belfer, et al. 1977; Bar-Yosef, Belfer-Cohen, et al. 1986), as well as further survey and investigation of the orientation of the tomb entrances (Bar-Yosef, Hershkovitz, et al. 1983; Hershkovitz, Arbel, et al. 1985). Since the return of the Sinai to Egypt as part of the 1979 peace treaty, published material has been included in broader studies of the wider region (e.g. Finkelstein 1995: 19), but no new research has been carried out.

Nawamis are circular, or sub-circular, tombs with a single chamber with a small, rectangular entrance (Rothenberg 1970: 21); they were compared in shape to beehives by early observers (Holland 1871: 543–544; Palmer 1871: 316–318). They are built from local, unworked stone, often sandstone slabs, but sometimes rounded cobbles (Bar-Yosef, Belfer, et al. 1977: 67; Hershkovitz, Arbel, et al. 1985: 204). They consist of a carefully constructed drystone double wall: the outer wall continues straight, while the inner wall is corbelled inwards with the gap at the top bridged with slabs; the space between the two walls is filled with rubble (Bar-Yosef, Hershkovitz, et al. 1983: 52; Rothenberg 1970: 21). Nawamis are usually between three and six metres in diameter, around two metres high, with walls between a metre and a metre and a half thick; the circular or sub-circular chamber is usually between 1.5 and 2.5m in diameter with a rubble floor, which is sometimes partially paved (Bar-Yosef, Belfer, et al. 1977: table 1; Bar-Yosef, Hershkovitz, et al. 1983: 52). They have a single square entrance with a lintel and slabs, oriented towards the west; originally this was thought to relate to local landmarks, but it has now been demonstrated that the variation in orientation closely matches the direction of the setting sun over the course of a year (Currelly 1906: 243; Bar-Yosef, Hershkovitz, et al. 1983; Hershkovitz, Arbel, et al. 1985).

Nawamis cemeteries are found across a relatively small area of the southern Sinai Peninsula (Figure 9.6). They are concentrated in the hills surrounding Mount Sinai/Gebel Musa: as far north as Wadi el-Biyar (Palmer 1871: 337); east to ‘Ein Umm Ahmed and the well known field at ‘Ein Hudrah (Bar-Yosef, Belfer, et al. 1977); south to Wadi Nasb where they were first excavated (Currelly 1906: 243–244); and west at a number of sites in Wadi Hebran (Hershkovitz, Arbel, et al. 1985: 210). They are found on the ridges and slopes of hills (Palmer 1871: 318; Bar-Yosef, Belfer, et al. 1977: 67; Bar-Yosef, Hershkovitz, et al. 1983: 53), often running along the course of a wadi (Peet 1915: 151; Currelly 1906: 244). Larger nawamis fields can consist of over 50 tombs (Hershkovitz, Arbel, et al. 1985: table 1), but they are also distributed in smaller groups of five or so, or even as lone structures (Palmer 1871: 316–318). In some cases nawamis have been reported to be associated with ephemeral settlements remains (Bar-Yosef, Belfer-Cohen, et al. 1986).

The majority of nawamis have been thoroughly looted in antiquity (Rothenberg 1970: 21) — the lack of human bone led the early surveyors to conclude that the structures were dwellings (Peet 1915: 152). However, early excavations established that they were tombs (Currelly 1906: 243–244), and more recent investigations have yielded MNIs of between one and six, three being average, with both sexes and a range of age groups sharing the same tomb (Bar-Yosef, Belfer, et al. 1977: table 4; Bar-Yosef, Belfer-Cohen, et al. 1986: table 12). The distribution of the human remains suggests that both primary and secondary burials took place in the tombs, and that bones appeared to

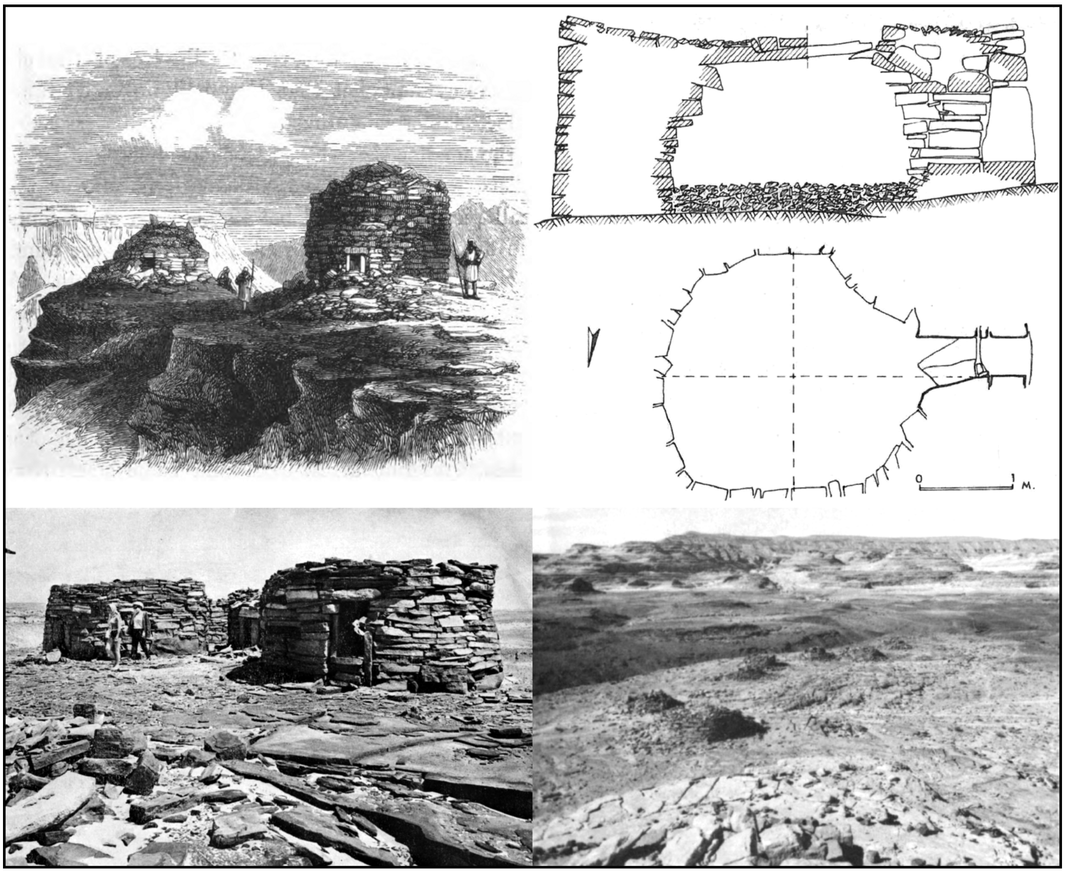


Figure 9.5: Plans and photos of nawamis in southern Sinai (altered after Palmer 1871: 371; Bar-Yosef, Belfer, et al. 1977: plate 9b; Goren 1980: figure 1; Bar-Yosef, Belfer-Cohen, et al. 1986: plate 17a)

have been pushed aside or rearranged to make room for further interments (Bar-Yosef, Belfer, et al. 1977: 72; Bar-Yosef, Belfer-Cohen, et al. 1986: 158). Examination of the human remains revealed three individuals from the same tomb with the same rare congential condition suggesting that they may have been very closely related (Hershkovitz, Kobyliansky, et al. 1982), and a more general dental profile of no caries but severe attrition (Bar-Yosef, Belfer, et al. 1977: 81). Evidence for more recent reuse includes an articulated Roman/Byzantine adult male (Bar-Yosef, Belfer-Cohen, et al. 1986: 160), and bedouin remains — with the tombs known to have been used until recently (Bar-Yosef, Belfer, et al. 1977: 81; Rothenberg 1970: 21). Grave goods include (Figure 9.7): flint flakes, transverse arrowheads, and a small number of other tool types; shell beads and jewellery; faience and carnelian beads; simple copper tools; bone tools; and very small quantities of pottery (Bar-Yosef, Belfer-Cohen, et al. 1986: 134–147; Bar-Yosef, Belfer, et al. 1977: 72–80; Rothenberg 1970: 21; Currelly 1906: 243–244; Palmer 1871: 318). The finds are consistent with a Chalcolithic to Early Bronze I date — the fourth and early third millennia BC (Bar-Yosef, Belfer-Cohen, et al. 1986:

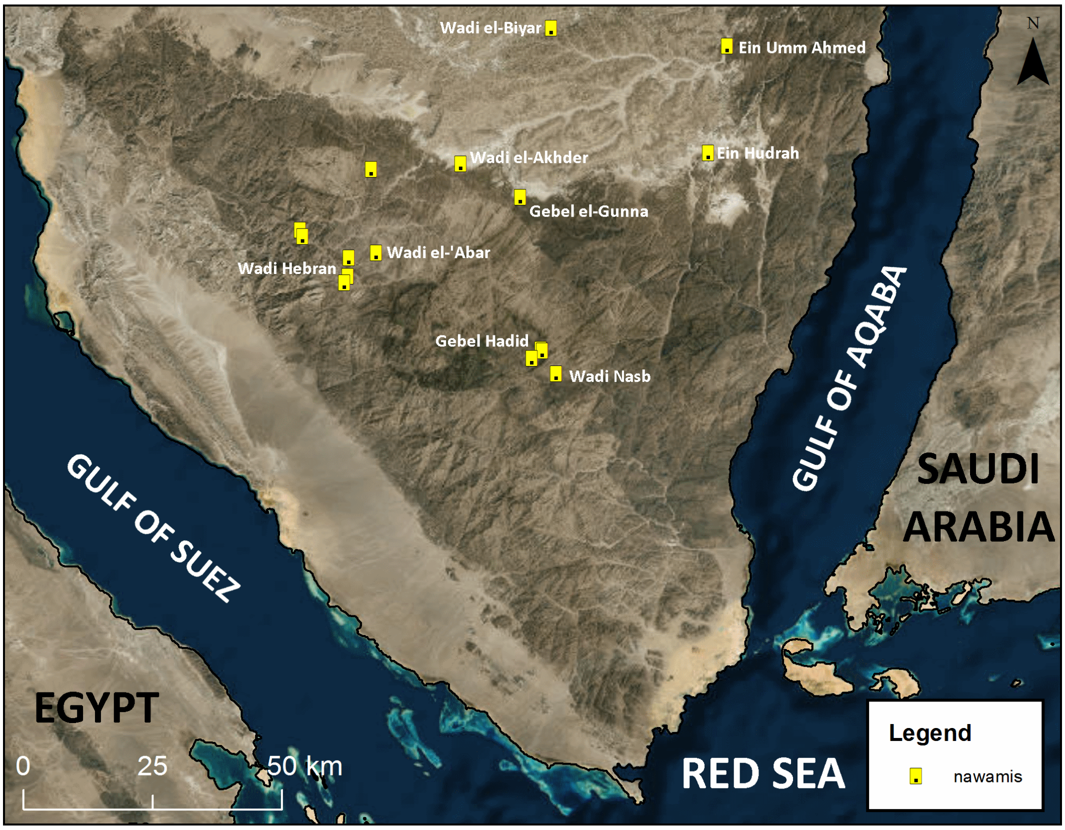


Figure 9.6: The distribution of nawamis sites in the southern Sinai Peninsula

164–165; Bar-Yosef, Belfer, et al. 1977: 86–88), although the inventory of much simpler burial cairns suggest that the Sinai stone tomb tradition dates to the Neolithic (Rosen 2011b: 73).

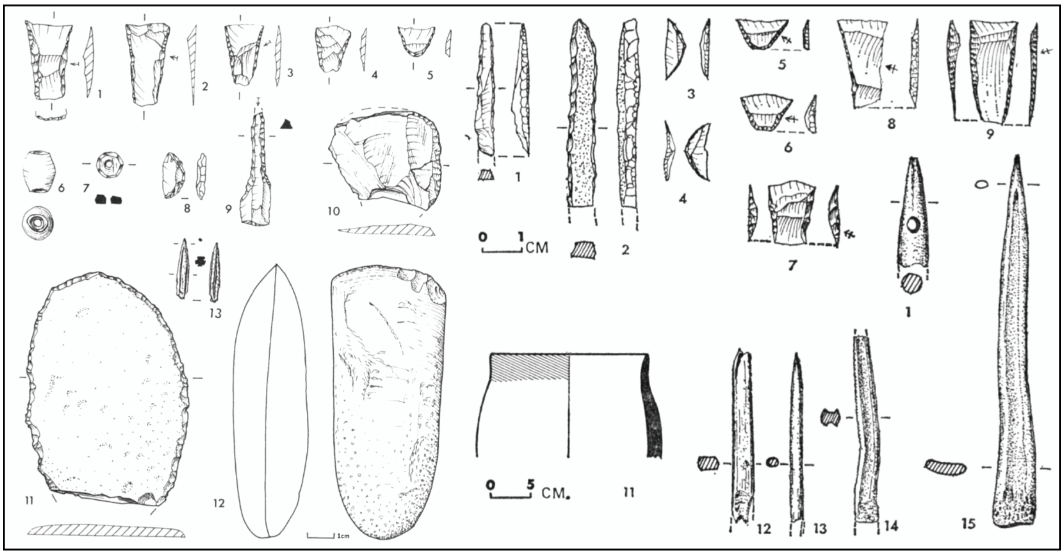


Figure 9.7: Grave goods recovered from nawamis (altered after Bar-Yosef, Belfer-Cohen, et al. 1986: figure 7; Bar-Yosef, Belfer, et al. 1977: figure 4)

It is unanimously thought that the nawamis builders were nomadic pastoralists (Anfinset 2010: 104; Finkelstein 1995: 19; Hershkovitz, Arbel, et al. 1985; Bar-Yosef, Belfer, et al. 1977: 87); the geography and climate of the Sinai support this, as historically the area has been inhabited by bedouin (Bar-Yosef, Hershkovitz, et al. 1983: 57). Ethnographic data and the little archaeological evidence available suggest that subsistence may have been based on goat-herding, horticulture, and some trade and copper mining (Bar-Yosef, Belfer, et al. 1977: 87). The orientation of tomb entrances at different nawamis fields suggest that not every site was inhabited throughout the year, with seasonal movement between summer and winter ranges (Hershkovitz, Arbel, et al. 1985: 209), possibly exploiting winter grazing in lower areas and spending summer higher up in the mountains where it is cooler (Bar-Yosef, Hershkovitz, et al. 1983: 58–59). The occurrence, in some localities, of multiple nawamis fields within a relatively small area may suggest that multiple populations coexisted in a relatively restricted area, similar to modern bedouin tribes (Hershkovitz, Arbel, et al. 1985: 210). More speculatively, it is thought that nawamis fields are tribal cemeteries (Finkelstein 1995: 19; Bar-Yosef, Belfer, et al. 1977: 87), and there is some direct evidence for kinship as the prime organisational factor in the society — analysis of the human remains from one tomb suggests that each grave was used successively by one family over several generations (Bar-Yosef, Belfer-Cohen, et al. 1986: 163). Both primary and secondary interments were made in the tombs, suggesting either that a single community had multiple burial grounds, or that when an individual died away from the tombs, they were buried temporarily and then dug up and interred when the group returned (Hershkovitz, Arbel, et al. 1985: 211). The orientation of the tomb entrances suggests that the sun played an important role in the society's belief systems and — speculatively — that this funeral ideology may have originated from contemporary Egypt (Bar-Yosef, Hershkovitz, et al. 1983: 56–57).

9.2.3 Burial cairns in Homs, Syria

Relatively little research has been conducted into the thousands of burial cairns known to cover the basalt landscape of the Homs region of Syria (Bradbury 2011: 1). The structures were first identified in Corona and modern satellite imagery by the SHR project, a multidisciplinary survey examining the settlement history and landscape development of the Orontes Valley in Syria (Philip, Jabour, et al. 2002; Philip, Abdulkarim, et al. 2005). Following on from this, Bradbury undertook an MA research project specifically examining the Homs cairns in the SHR's northern study area — including their distribution, form and chronology — through a combination of fieldwork and remote sensing (Bradbury 2009; Bradbury and Philip 2011). This work was developed further in a PhD thesis, investigating the cairns in greater detail, as part of the broader regional context in an effort to examine the role of the structures within processes of social reproduction in the 'non-optimal' geographical zones of the Near East (Bradbury 2011). The cairns have also been investigated by a Syrian-Spanish team as part of an archaeological project surveying the Homs Gap, west of the Orontes River (Armendariz et al. 2011).

Homs cairns are a heterogeneous group that shows considerable variation in their shape, size, construction, and their associated archaeological features (Philip, Jabour, et al. 2002: 16; Bradbury 2009: 67). There is substantial variation in the shape of the cairns, but the vast majority are circular, irregular or ovoid, with only a very small proportion being square or rectangular (Bradbury 2011: 202; Bradbury and Philip 2011: 175). All are constructed from the local basalt, but there is considerable variation in the material: rubble, block or cobble matrices are common, while soil-filled cairns make up a tiny minority (Armendariz et al. 2011: 55; Bradbury 2011: 205). The size of the cairns varies considerably (Bradbury 2011: 212), the biggest reach up to 20m in diameter, and the smallest only 3m (Armendariz et al. 2011: 55). Burial chambers are common in the medium and large cairns (Figure 9.8), formed from basalt slabs and covered by stones; they can be rectangular, polygonal or circular in shape and are usually small in size, less than 2m in length/diameter (Armendariz et al. 2011: 55–56). The cairns were frequently built on top of natural boulders, otherwise cuts were made into the basalt flow to insert upright slabs (Bradbury 2009: 69). Over 80% of the cairns surveyed by Bradbury boasted at least one associated feature; as well as internal cists, the most common are external revetments and wall lines or enclosures, but monoliths, paving and platforms were also observed (Bradbury 2011: 189; Bradbury and Philip 2011: 175). In general, the larger the cairn the more complex the monument with the greater number of additional features (Armendariz et al. 2011: 55), but there are exceptions and the correlation is not straightforward (Bradbury 2011: 184–187). Evidence for the addition of new material well after the original construction of the cairns was noted, as well as the adaptation of monuments for modern use as windbreaks or as part of field boundaries (Bradbury and Philip 2011: 175).

Although similar structures have been reported all over the southern Levant (Prag 1995; Zohar 1992), these particular cairns are distributed across the Orontes valley of western Syria and are especially associated with basalt geology (Bradbury 2011: 245–248). Ground survey of cairns has been carried out in a ~150 sq-km upland area northwest of Homs on the volcanic plateau of the Wa'ar (Bradbury 2011: 42), and further south and west in the Homs Gap between the western bank of the Orontes river and the Bouqaia Basin 30–40 km to the west (Armendariz et al. 2011: 55, figure 1). However, remote sensing has been used by the Vanishing Landscape project to map over

Figure 9.8: Homs cairn chamber architecture (altered after Philip and Bradbury 2010: figure 9; Armendariz et al. 2011: figure 3)

130,000 cairns across the wider area (Figure 9.9), covering over 21,000 sq-km (Bradbury 2011: 245). Within the local landscape, cairns generally occupy the slopes and crests of the main ridges, with far fewer in the arable fields along the bottom of the main wadi systems (Bradbury and Philip 2011: 173), but in larger necropolises the monuments form a continuous distribution covering the entirety of the upland terrain (Armendariz et al. 2011: 56). Cairns are located away from major wadi systems and seasonal lakes, over 60% are over 500m from wadis, and 40% from either (Bradbury 2011: 250, figures 6.4, 6.5). Geology is a critical factor in tomb distribution, with the structures showing a clear relationship with basalt (Armendariz et al. 2011: 55). Bradbury reports that no cairns were observed in the Southern Marls or the Northern Alluvium/Marls, and in the wider area, of the 169,800 suspected cairns mapped by remote sensing over 90% intersected with basalt geology and many of those that did not were situated within a short distance of it (Bradbury 2011: 245–246). A major feature of the distribution of the Homs cairns is their density: within the SHR/Bradbury northern study area almost 30,000 cairns were located within the ~120 sq-km area, an average of 208 structures/sq-km (Bradbury and Philip 2011: 173); in especially dense areas as many as 721 cairns were recorded within a square kilometre (Armendariz et al. 2011: 56). This remarkable distribution continues across the wider area, the average density of the over 150,000 suspected cairns located by remote sensing in basalt areas is 91.6/sq-km (Bradbury 2011: table 7.1, 245–246). Another striking feature of the distribution of the Homs cairns is their association with other archaeological remains (Figure 9.10) — the basalt landscape is a complex network and palimpsest of stone walls, structures and cairns (Philip, Abdulkarim, et al. 2005: 27, 34; Philip and Bradbury 2010). Rectangular and oval enclosures are frequently observed in very close proximity to the cairns, and may have originally been domestic structures and sheepfolds (Armendariz et al. 2011: 64). In some cases cairns are connected by wall lines that run between them (Bradbury and Philip 2011: 175), although the chronological relationship between the structures is not always clear (Bradbury 2009: 69).

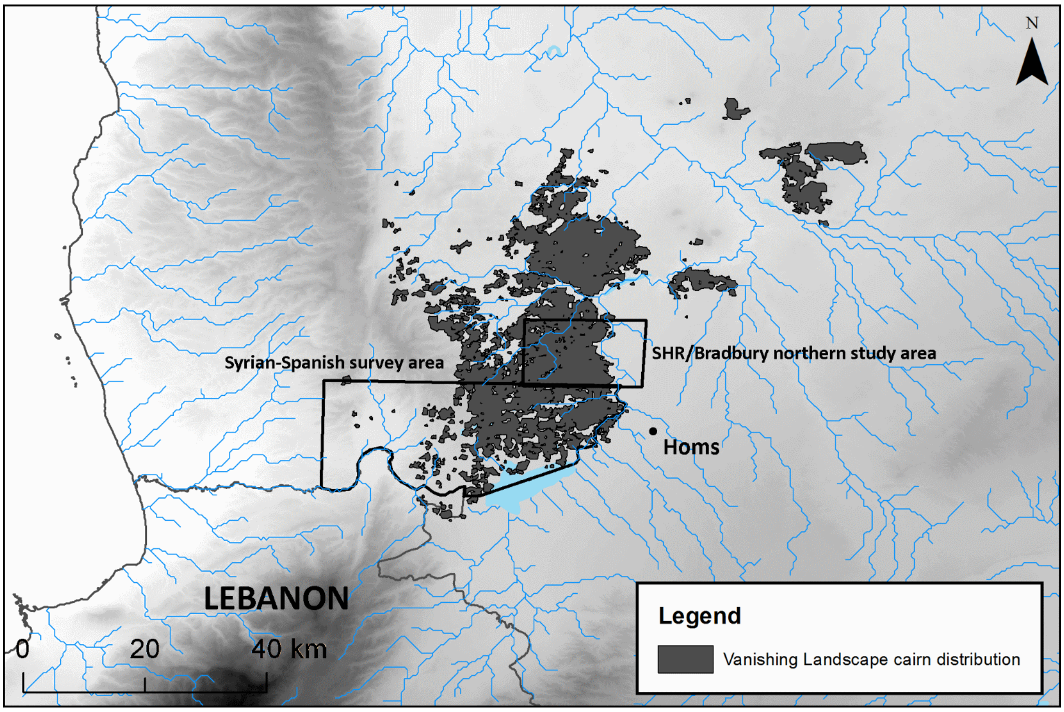


Figure 9.9: The distribution of suspected burial cairns in the Homs region of western Syria (data from Bradbury 2011: figures 6.13, 7.2; Armendariz et al. 2011: figure 1)

No Homs cairns have been fully excavated (Armendariz et al. 2011: 64), although looted and damaged examples clearly show the presence of burial chambers, with some diversity in the number and shape of the chambers (Bradbury 2011: 491). Bradbury has carried out a series of cairn surface pick-ups as part of her fieldwork (2009; 2011: 220–244). Nearly three-quarters of the 203 cairns sampled yielded no associated dating material, and only 27 revealed diagnostic pieces (Bradbury 2011: 220). Eleven produced Chalcolithic to Early Bronze Age material, at least twelve produced Hellenstic–Roman finds, a further twelve yielded Islamic material, while other periods were less well represented (Bradbury 2011: table 5.1). Analysis of the evidence suggests that the Chalcolithic–Early Bronze Age was the main period of cairn construction, with some structures also being built during the Hellenestic–Roman period (Bradbury 2011: 223). The fourth and third millennia BC finds include pottery and flint and obsidian lithic material (Bradbury 2011: 229–236).

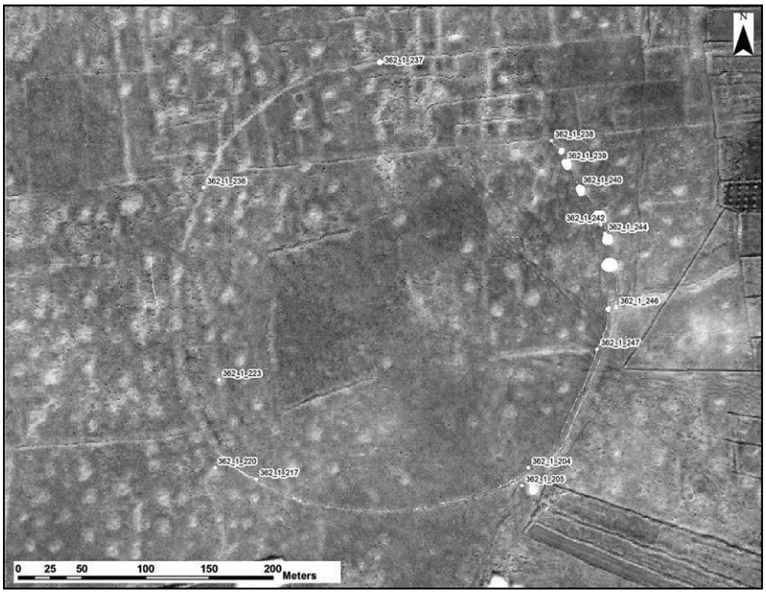


Figure 9.10: An example of the complex palimpsest of cairns, walls and enclosures in the Homs region (altered after Philip and Bradbury 2010: figure 10)

Although relatively little research has been carried out into the Chalcolithic and Bronze Age populations in the basalt uplands of the Homs region, archaeologists have been keen to interpret the evidence in order to better understand these societies. While cairns in the southern Levant have often been attributed to nomadic pastoralists, it is possible that these upland cemeteries were constructed by sedentary populations that farmed the more fertile lowlands (Armendariz et al. 2011: 65), but what is more likely is that the cairn builders adopted a mixed subsistence strategy (Bradbury and Philip 2011: 177). The ‘sub-optimal’ climate and geography of the region lead to seasonal variability in the availability of different resources that would have encouraged the population to exploit different areas at different times of the year (Bradbury 2011: 279). A multi-focal subsistence strategy relying solely neither on agriculture nor pastoralism would have allowed herds to be grazed in the uplands in the winter and early spring while crops germinated and grew in the valley bottoms, and returned to pasture on the stubble after the harvest in the early autumn (Bradbury 2011: 286–287). The sheer number of cairns in the region suggests that this form of burial cannot have been the preserve of elites, and in fact there is no evidence of a recognisable elite during this period (Bradbury and Philip 2011: 177; Bradbury 2011: 299). It is possible that status and power were emphasised through other means, but it is more likely that the society was heterarchically organised, with differentiation and social status embedded within a communal/group identity (Bradbury 2011: 299). The construction of burial cairns would have reinforced group cohesion and solidarity (Bradbury and Philip 2011: 177).

9.2.4 Hafit tombs in their wider context

The three case studies of the stone tomb phenomenon presented above perform two roles: to shed light on Hafit society through comparisons with neighbouring, contemporary populations facing similar challenges; and to showcase what the northern Oman Peninsula can add to the discussion of fourth and third millennia BC societies in the Near and Middle East. Yemen HCTs and Sinai nawamis show marked similarities to the Hafit dataset, while Homs burial cairns form an enlightening contrast. While compared to these localities, the northern Oman Peninsula offers an extensive, well preserved funerary dataset that is under relatively little threat, clear, relatively well understood and published, and — a sad reality — occupies two safe and politically stable countries. There is insufficient space to fully explore the great potential of the Hafit archaeology as part of the wider stone tomb phenomenon, but it is possible to demonstrate a need for further research.

The Yemeni HCTs and the Sinai nawamis share remarkable architectural parallels with Hafit tombs. All are circular, drystone structures with a single round chamber and a side entrance; they are all corbelled to form a false dome roof and use a double-wall, rubble fill construction. On average they are very similar in size: 3 to 6m in diameter and 2m tall. Nawamis and HCT entrances were constructed oriented to the setting sun, and in the eastern part of the northern Oman Peninsula Hafit tomb entrances match the direction of sunrise. The tombs are extremely similar, but also have their own distinctive features: in HCTs the edgewise slab lower course, raised entrances and tails; in Hafit tombs the more pronounced inward slope of the outer walls, the easterly entrances and the frequent addition of extra ringwalls; and in nawamis a somewhat squat appearance. It would be an extraordinary coincidence for these contemporary tombs, from neighbouring regions to have been constructed independently and yet be so similar in their form, but it is also difficult to explain the connection between them. It is most likely that the tomb design was shared as part of inter-regional trade, and adopted from a common source, although the only possible indication of this in the grave furnishings are faience and carnelian beads, and copper which may or may not have been indigenously produced in each of the three regions (Rothenberg 1972; Weeks et al. 2009; Begemann et al. 2010). An explanation for this architectural similarity clearly merits further investigation.

There are also common patterns in tomb distribution in Sinai, Yemen and the northern Oman Peninsula that are not shared by the Homs cairns. As with Hafit tombs, HCTs and nawamis were built in elevated positions that make the structures highly visible and appear to have efficiently advertised access rights or ownership of territory or resources; this is not as marked in the Homs region where burial cairns cover large swathes of upland areas. Moreover the distribution of tombs in Yemen, Sinai and the northern Oman Peninsula has a clear spatial relationship with wadi systems — tombs frequently overlook water courses; in Syria burial cairns are situated away from wadis and seasonal lakes. In terms of the number and density of Hafit tombs, HCTs show the greatest similarity with a combination of very dense cemeteries and lower density areas, the distribution of the nawamis is similar but with much fewer tombs in the larger cemeteries. The density of the Homs burial cairns is remarkably different: an incredible 30,000 suspected cairns were located within an area of only 120 sq-km in the SHR northern study area, and further west as many as 721 cairns were recorded within a single square kilometre. Although a significant proportion of these may have been constructed after the fourth and third millennia, this nevertheless indicates an intensity in the occupation of the landscape far greater than is apparent from Hafit tombs, HCTs and nawamis. This is perhaps unsurprising given that the Homs area enjoys lower temperatures and significantly higher rainfall, a point that underlines the similarity between the arid climates of Sinai, Yemen and the northern Oman Peninsula, as well as other known tower tomb areas (Figure 9.11). Similarly, the non-funerary remains associated with the Homs cairns are much more substantial than the ephemeral features observed in close proximity to nawamis, HCTs and Hafit tombs.

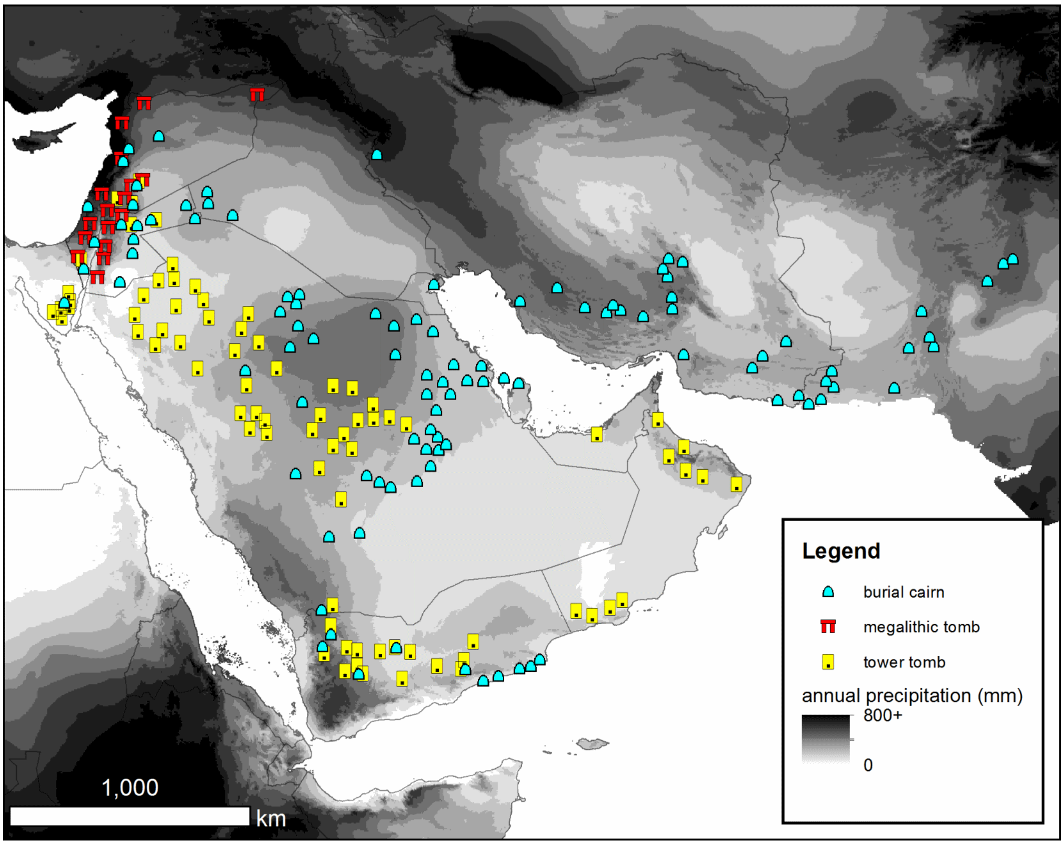


Figure 9.11: A WorldClim model of total annual precipitation and the distribution of stone tomb types in Southwest Asia, (tomb data as figure 9.11, climate model from Hijmans et al. 2005)

The interpretation of the economy and socio-political organisation of fourth and third millennium BC society in Yemen's Jawf-Hadramawt basin, southern Sinai and western Syria should provide some insight into the nature of Hafit society. With regards to subsistence, in Yemen and Sinai the populations are unanimously described as nomadic pastoralists, perhaps beginning to make some limited use of arable agriculture, but which rely on herding. In western Syria, which boasts contemporary 'tell' settlement sites in the basalt and urbanised populations in the region (Wilkinson et al. 2014: 46, 74–75; Philip and Bradbury 2010: 161–162), the cairn builders appear to have relied equally on arable agriculture and pastoralism as complementary strategies allowing seasonal resources to be exploited in different parts of their territory. The clear comparison between the funerary datasets of Sinai, Yemen and the northern Oman Peninsula, and the contrast with Homs cairns, suggest that the Hafit population also relied on a nomadic pastoralist lifestyle. Tomb entrance data from Hafit tombs, HCTs and nawamis, suggest that the populations may have a shared a similar seasonal migration pattern exploiting seasonal resources in an arid environment, and possibly a common significance of the sun in their ideology and belief systems. It is possible that all three are snapshot examples of a lifestyle and ideology common to the arid areas of Arabia and the southern Levant, demarcated by the distribution of tower tombs.

9.3 Conclusion

The Hafit period marks a watershed in the prehistory of the northern Oman Peninsula, but its tombs are also only part of a much wider phenomenon. In the 4th and 3rd millennia BC, stone tombs were constructed across large parts of Southwest Asia — tower tombs, burial cairns and megalithic tombs in southern and western Arabia, the southern Sinai and the southern Levant. Although there is considerable variation between these funerary datasets, and it is important not to overemphasise the similarities given that there are a limited number of ways to dispose of the dead in an arid and rocky region, this stone tomb phenomenon is a remarkable archaeological anomaly. Not only does this wider context provide a rich body of comparative material with which to shed light on Hafit society, but it also enables the northern Oman Peninsula to contribute to discussions of themes and challenges common to Neolithic/Bronze Age Near and Middle Eastern societies. Moreover, this wider region was a common source of new resources and technologies to the local population before, during and after the Hafit period, and stone tombs may prove to be another — highly visible — import that may help to establish the mechanisms behind this transmission of goods and ideas.

Three cases studies of the stone tomb phenomenon were examined in detail from western Syria, southern Sinai and central Yemen. The Yemeni HCTs and Sinai nawamis are remarkably similar to Hafit tombs in their architecture and distribution, while the Homs burial cairns provide an enlightening contrast. As in the northern Oman Peninsula, 4th and 3rd millennia societies in Sinai and the Jawf-Hadramawt basin in Yemen appear to have been made up of seasonally nomadic pastoralists, while the much denser population of the Homs basalt were semi-sedentary farmers and herders that intensely exploited the richer landscape. It is possible that Hafit tombs, HCTs and nawamis are local variations of a lifestyle and ideology common to the arid areas of Arabia and the southern Levant, demarcated by the distribution of tower tombs. This is important as explanations for the development of Early Bronze Age society have frequently been sought in external contact with regional powers (e.g. During-Caspers 1971; Orchard 1995; Ratnagar 2001), while this suggests that we need to look internally at Arabia and Arabian societies and societal development for an understanding of this phenomenon rather than to outside stimuli. The 4th and 3rd millennia BC stone tomb phenomenon in Southwest Asia merits much further examination, while the potential of the Hafit tomb dataset to add to the discussion of Neolithic and Bronze Age societies in the Middle and Near East demands more detailed research.

Conclusion

Despite the fact that archaeologists have been investigating the Hafit period for half a century, our understanding of the economy and the socio-political organisation of the late fourth and early third millennium BC population in the northern Oman Peninsula is still very limited. Moreover, despite its historical significance, agricultural importance and heavy population density, remarkably little archaeological research has been carried out in the Batinah region of Oman, with very few Early Bronze Age sites known there in comparison to Dhahirah, Dakhiliyah and Sharqiyah on the other side of the Hajar Mountains. In an attempt to begin to address these gaps in our knowledge, the aim of this thesis is to explore the Batinah's Hafit archaeological dataset within the context of the northern Oman Peninsula and the wider region in order to consolidate our understanding of Hafit society. With such an ambitious aspiration, remote sensing and GIS formed the core of data collection and analysis in the research design, with Google Earth-based survey of Hafit tombs taking a major role. Due to the structure of the thesis, each chapter acts as a mini project and presents its own conclusions, so the role of this chapter is to summarise these and consider potential areas for future research.

Major findings

The first part of the thesis was a literature review, and in Chapter 1 the published archaeological evidence related to the Hafit period was reviewed. The somewhat limited and contentious settlement evidence and the much more plentiful funerary dataset were comprehensively summarised, examining each potential Hafit settlement and précising Hafit tomb architecture, distribution, furnishings and human remains evidence. Chapter 2 presented published opinion regarding the nature of Hafit society, summarising the full extent of the discussion of the subject from the earliest hypotheses and theories to present attitudes. The meagre material presented in the chapter highlights a general dearth of debate as to how society functioned during this period in the northern Oman Peninsula.

Part II consisted of data collection and analysis. Chapter 3 described an attempt to assess the reliability of the Google Earth survey of Hafit tombs in western Ja'alan, northeastern Oman. Using remote sensing it repeated the meticulous ground-based archaeological survey of a small area, carried out by a Sultan Qaboos University team, and compared the results to gauge the accuracy and precision of Google Earth Hafit tomb survey. It concluded that approximately half of Hafit tombs are visible on the satellite imagery with their condition a major determining factor, and that the precision of the remote sensing survey was excellent with the identification of Hafit tombs proving to be very reliable.

In Chapter 4 the results of a low resolution survey of the distribution of Hafit tombs across the northern Oman Peninsula using Google Earth were presented and analysed. The relative density and ubiquity of Hafit tombs was assessed using a timed sampling survey method in 873 10km grid squares, and these ordinal results were quantified through a more detailed survey to generate a rough estimate of the total surviving number of Hafit tombs — 53,236 — and the average size of the Hafit population that inhabited the area — 11,344–28,588. The NOP-GE survey results were also analysed with GIS to model the distribution of Hafit tombs within their natural and anthropogenic environment, revealing that in general the population appears to have preferred the low foothills on either side of the Hajar Mountains, and that occupation areas showed a clear relationship with hydrology and copper ore sources.

Chapter 5 detailed a tomb-by-tomb Google Earth survey of the Batinah and a GIS analysis of the results. Google Earth was used to map the location of every visible Hafit tomb, and any similar Later Prehistoric Tombs, first in six transects and then across the whole of Al-Batinah. Groundtruthing was carried out to ensure that Hafit cemeteries were not being missed and to assess the reliability of attempts to distinguish Hafit tombs from LPTs. Two phases of Google Earth survey were carried out, the first using a 1km grid to locate Hafit and LPT cemeteries, and the second using a 12 arcsecond grid in order to distinguish Hafit tombs from LPTs more accurately in these areas. In the final phase over 6,000 suspected Hafit tombs and nearly 8,500 LPTs — mostly Cell Graves with some Honeycomb Tombs and other types — were located in Google Earth. GIS analysis was used to analyse the spatial and environmental distribution of Hafit tombs, the LPT dataset was also analysed to provide a comparison. The distribution of Hafit tombs in the Batinah is unique in the northern Oman Peninsula. Tombs are concentrated in the low bajada hills that run parallel between the coastal plain and the mountains, away from areas of recent/traditional settlement, and show a sparse but continuous distribution. A strong relationship between Hafit tombs and a linear outcrop of Tertiary rock was demonstrated, this geological formation may have formed an aquiclude that brought water to the surface and made certain parts of the bajada zone attractive to the Hafit population. The Hafit tombs also show a strong relationship with the Batinah's copper ore sources.

As a foil to the remote sensing-based data collection of the previous studies Chapter 6 described the detailed ground survey of three Batinah Hafit cemeteries at Halban, Wadi al-Hoqain and al-Hamid. Each Hafit tomb and LPT at these three sites was recorded in detail on the ground. The density and architecture of the Hafit tombs at these cemeteries is unusual. Each site boasted an unusually high number of Hafit tombs, and the structures suggest that exceptional care and effort was taken in their construction compared to most Al-Batinah Hafit tombs. One tomb at each site is much larger than its neighbours, while numerous tombs show particular finesse in their wall facing, both these characteristics hint at the chronological development of funerary archaeology in the Batinah as well as changes in later Hafit social structures.

Chapter 7 reported on the Desert Surface Survey, an attempt to locate and record Hafit settlement remains in the Batinah. A 30 hectare area at the site of al-Buyraq in the southern Batinah, surrounded by Hafit tomb-lined hills on three sides, was meticulously surveyed by field-walking transects spaced 10m apart. Any possibly anthropogenic features were flagged and hundreds were recorded — mostly stone features on top of or embedded into the deflated desert pavement — including possible hearths, hut-circles/tent-rings, and semi-circular stone arrangements. The ephemeral nature and sparse but patchy distribution of the features is consistent with that of a camping ground used repeatedly over a lengthy period of time. The site was virtually aceramic, and only a small assemblage of non-diagnostic and crude lithics were recovered, both are consistent with a Hafit date, but this could not be confirmed with certainty.

The third part of the thesis comprised the discussion and conclusion. In Chapter 8 the data and analysis of the previous chapters was brought together with the published evidence in an attempt to provide fresh insight into Hafit society. Hafit subsistence, the wider economy, and politics and ideology were discussed. It was argued that nomadic pastoralism was the primary Hafit subsistence strategy rather than sedentary agriculture, and that in some areas this was supplemented with food resources from the coast. The case was also made for the gradual sedentarisation of the Hafit population towards the end of the period. Copper seems to have been central to the wider Hafit economy, especially in Al-Batinah, and is likely to have contributed both to a lively local exchange system and international trade. The Hafit population appears to have become more specialised as the period progressed, with new skills emerging and being developed. It is argued that the northern Oman Peninsula was divided into territories occupied by small, related nomadic groups, centred around wadi basins and, in the Batinah, Tertiary aquiclude outcrops. Territoriality — the expression of ownership or access rights to resources — was expressed through the construction of Hafit tombs in highly-visible positions and, in some cases, a contrasting juxtaposition of building materials. A case is also presented for a common Hafit social structure and ideology across the northern Oman Peninsula, but with local variations, especially between the eastern and western parts of the region. The question of social change in the Hafit period is also explored, with the possibilities of emergent social stratification and the deliberate galvanisation of an egalitarian model being considered.

In the final chapter the Hafit archaeological dataset was considered within its wider geographical, regional context — the phenomenon of stone tomb construction in Southwest Asia in the fourth and third millennia BC. The anomalous occurrence of megalithic, cairn and tower tombs in the Near and Middle East that are broadly similar to contemporary Hafit funerary structures was discussed, and three case studies examined in detail from central Yemen, southern Sinai and western Syria. Despite some continuing unknowns regarding the precise chronology of these structures, it was argued that Arabian tombs show distinct similarities in their architecture and distribution, raising the possibility that the Hafit dataset was a local expression of a lifestyle and ideology common to the arid areas of Arabia and the southern Sinai at this time.

However, while many of these conclusions regarding the nature of Hafit society are significant, they must be tempered with some caution due to lingering questions as to the reliability of the thesis' primary means of data collection. Google Earth was used to collect data on Hafit tombs in Chapters 3, 4 and Chapter 5 and while groundtruthing and other data strongly indicate the overall reliability of this approach, it is also clear that when the preservation of the tombs is poor, distinguishing them from Later Prehistoric Tombs can be difficult (Chapter 4.2). For the moment the present author is confident of the data presented in these chapters within the confines of the limits of accuracy stated, but as new data is accumulates and as more tombs are excavated then the reliability question will need to be constantly revisited and the results presented here updated accordingly.

Original contributions

This thesis has made a significant contribution to the discussion of the Hafit period in the northern Oman Peninsula. The literature review provides the most detailed summary of the Hafit archaeological dataset (Chapter 1) and opinion regarding the nature of Hafit society (Chapter 2) of any yet published. The NOP-GE survey boasts by far the largest area of any Hafit tomb survey, and represents the first ever attempt to map the relative density of the tombs accurately at such a scale, covering over 80,000 sq-km (Chapter 4.3.1). The estimate of the number of surviving Hafit tombs in the northern Oman

Peninsula is only the second to have been suggested, and the first that uses a scientifically reproducible methodology. The estimate of the average size of the living Hafit population is the first to be presented (Chapter 4.4). Prior to this thesis only a small handful of Hafit sites were known in the Batinah, the B-GE survey has located some 6,000 suspected Hafit tombs from across the 12,500 sq-km area of the Batinah — as well as an even greater number of LPTs (Chapter 5.3). GIS analysis of these results has also modelled the unique distribution of the Batinah Hafit tombs, and explored the role of the suspected Tertiary aquiclude (Chapter 5.4). The survey of Hafit cemeteries of Halban, Wadi al-Hoqain and al-Hamid has provided a unique insight into the development of Hafit funerary architecture, recording some of the largest Hafit tombs known in the whole of the northern Oman Peninsula (Chapter 6). The discovery and survey of the possible Hafit settlement site at al-Buyraq is a major contribution as only a very small number are known from the period; the research also represents the first ever attempt specifically to locate settlement remains based on the distribution of Hafit tombs (Chapter 7). The exploration of Hafit society in Chapter 8 represents the lengthiest and most detailed treatment of the subject anywhere in the published literature, adding considerably to our efforts to understand how the Hafit population lived. While the fourth and third millennia BC stone tomb phenomenon of Southwest Asia has been considered in detail elsewhere, this thesis includes the most thorough treatment of the subject from the perspective of eastern Arabia and is the first to highlight the potential for the Hafit tomb dataset to add to the discussion (Chapter 9).

Future research

Having said all of this, there is still obviously considerable scope for future research that emerges from this thesis. Other variables that may have influenced the regional distribution of Hafit tombs and occupation areas (Chapter 4.5.1) merit analysis — including geology, soils and ground water hydrology. The NOP-GE results could also provide a valuable guide for locating important Hafit cemetery sites that are as yet undocumented, especially the only '3' grid square in the interior of Oman, near the village of Izz, that does not correspond to a published site (Chapter 4.3.3). The B-GE survey highlights the great deal of research that remains to be done in the region (Chapter 5.3). Each of the many Hafit cemeteries located should be investigated in detail on the ground, especially in light of the rapid development of infrastructure in the Batinah. Moreover, the Batinah's LPTs merit much more detailed investigation, especially as they lie largely outside of the scope of this thesis — detailed typological and chronological research should be carried out to discover what they are and when they were built. More broadly, further research should be carried out investigating the effect of the possible Tertiary aquiclude on the hydrology of the region, testing its effect on groundwater depth in greater detail. Further profitable analysis of both the B-GE and NOP-GE datasets could be carried out if suitable land-use data for the region could be sourced or generated. Issues of relative chronology at the Hafit cemeteries of Halban, Wadi al-Hoqain and al-Hamid (Chapter 6) may only be resolved by excavation — if such research was to be carried out, it could help to shed light on which tombs where in use at the same time, and therefore provide much greater insight into social change at the end of the Hafit period. The wealth of material remains discovered at the Hafit site of al-Buyraq demonstrate the effectiveness of the methodology, which could easily be employed elsewhere in the Batinah and across the northern Oman Peninsula (Chapter 7). Locating further possible Hafit settlement sites, especially alongside much more detailed study of their lithic assemblages, could greatly assist in confirming or refuting the predominance of nomadic pastoralism in this period in the northern Oman Peninsula. While a great deal of progress has been made to stimulate and advance the discussion of Hafit subsistence, the wider economy and politics and ideology (Chapter 8), a great deal remains to be securely established regarding the nature of Hafit society. Much further research needs to be carried out into the Hafit funerary dataset as part of the stone tomb phenomenon in Southwest Asia (Chapter 9), especially with regards to how the northern Oman Peninsula can contribute to the wider thematic discussions of Neolithic and Early Bronze Age societies in the Near and Middle East. Moreover, the question of the role of outside influence of foreign powers versus indigenous Arabian processes in the development of similar fourth and third millennium BC societies across the arid areas of the Arabian Peninsula and Sinai demands further attention.

The aim of this thesis was to explore the Hafit archaeological dataset of the Batinah within the context of the northern Oman Peninsula and the wider region in order to consolidate our understanding of Hafit society. This has been fully met. It is to be hoped this research may stimulate further discussion of the subject, as despite the progress that this thesis has made, a detailed understanding of Hafit society remains a long way off.

Appendices

Appendix A

Hafit and Umm an-Nar site database

Nowhere in the literature is there a comprehensive list of the Early Bronze Age sites of the Oman Peninsula. I decided to create one as I was undertaking my literature review, both as a way of ensuring that my research was thorough, and also to use in maps and analysis. The database is restricted to Hafit and Umm an-Nar sites: the Hafit period is the focus of the thesis; and the Umm an-Nar sites form one of the datasets utilised in data analysis. To my knowledge all sites that are contained within the published literature are included, as well as those that could be verified from accessible unpublished material.

As well as information to identify each site (name and site code, when applicable), each table contains basic data regarding the location of the site (GPS coordinates, country, area), the archaeology (settlement, tombs), the research (excavation, survey), and bibliographical references. There are three individual tables: confirmed Hafit sites; possible Hafit sites; and Umm an-Nar sites. Coordinates are given as WGS 1984 Latitude and Longitude to a varying number of decimal places depending on the degree of accuracy that was possible in locating each site. 'Regions' refer to the pre-2006 major administrative divisions of Oman, and the emirates of the U.A.E. The 'references' field contains every publication, or piece of grey literature, known to the author that contains original research from the period of interest at the site, but excludes publications that only deal with artefactual, environmental or human remains evidence. In the case of true/false fields, true is denoted by a checkmark (✓) and false by an absence.

A.1 Hafit sites

The collection of Hafit period sites are split into two tables: Hafit sites (Table A.1, Figure A.1) and possible Hafit sites (Table A.2, Figure A.2). The sites included in the latter table are all funerary sites that were located during archaeological surveys. None were excavated and so the table lacks the 'Tomb', 'Settlement', 'Survey' and 'Excavation' fields. These sites are treated as only possibly dating to the Hafit period, as they consist of funerary structures that cannot be dated accurately from their description, either by the authors or by myself based on their records, but which could be attributed as Hafit. The table includes a 'description' field that quotes or summarises the account of the funerary structures found at each site.

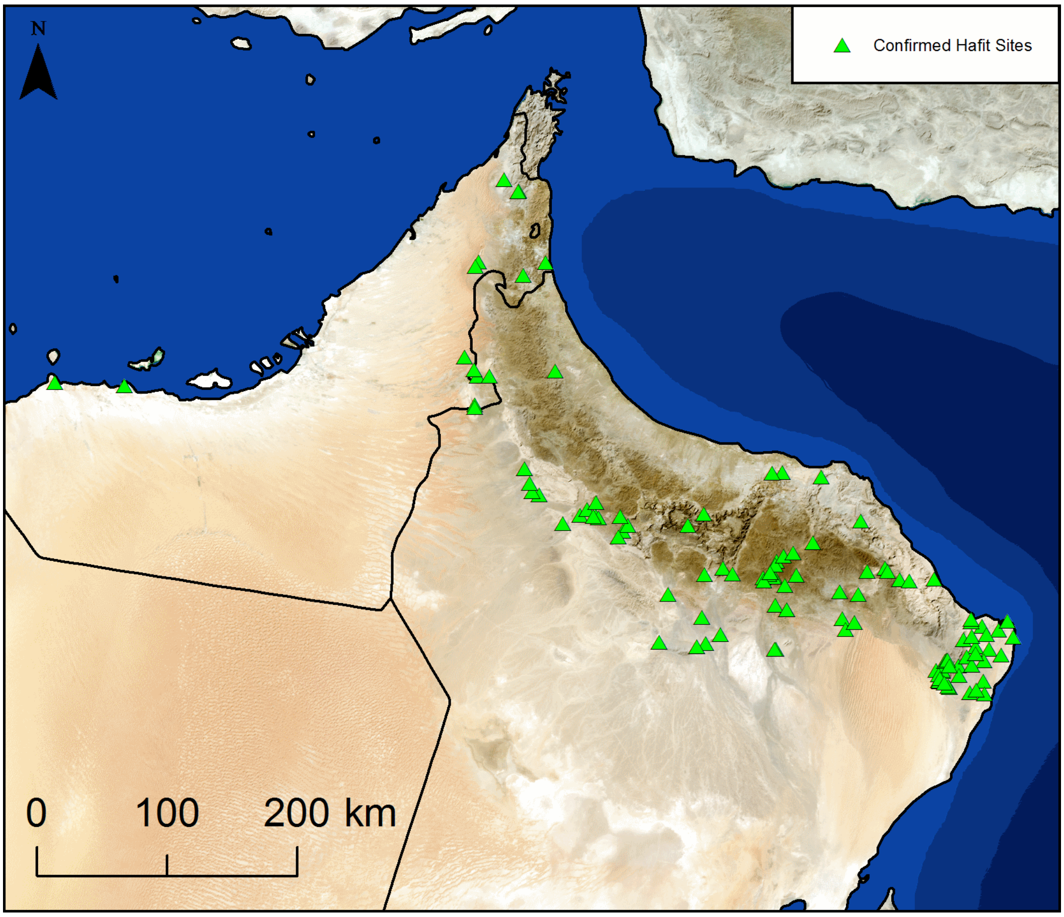


Figure A.1: Map of confirmed Hafit sites

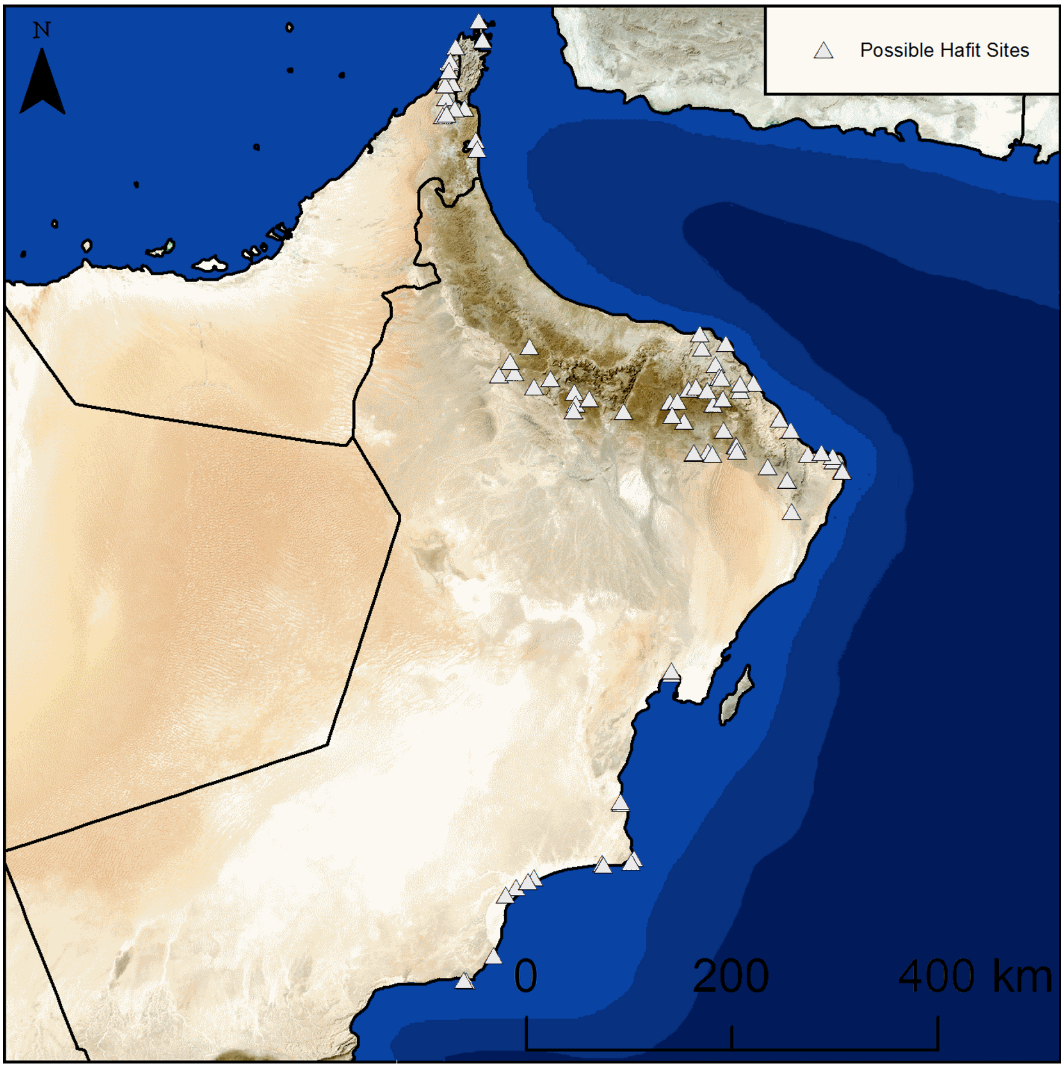


Figure A.2: Map of possible Hafit sites

Table A.1: Hafit sites

Site Name	Site Code	Tombs	Settlement	Survey	Excavation	Lat	Lon	Country	Area	Reference
Ablah	45	✓		✓		23.1782	56.9178	Oman	Dhahirah	(de Cardi, Collier, et al. 1976)
Abu Silah		✓		✓		23.43	56.29	Oman	Dhahirah	(Williams and Gregoricka 2013)
Ad-Dariz North		✓		✓		23.29	56.6	Oman	Dhahirah	(Cable n.d. 2012)
Ad-Dariz South		✓		✓		23.28	56.72	Oman	Dhahirah	(Cable n.d. 2012)
Aflaj	17	✓		✓		22.6321	58.1452	Oman	Sharqiyah	(de Cardi, Collier, et al. 1976)
Aflaj		✓		✓		23.45	56.24	Oman	Dhahirah	(Williams and Gregoricka 2013)
Al-Ayn		✓	✓	✓		22.36	59.55	Oman	Sharqiyah	(Giraud 2010; Blin 2007)
Al-Ayn		✓		✓	✓	23.22	56.96	Oman	Dhahirah	(Döpper and Schmidt 2014; Schmidt 2011; de Cardi, Collier, et al. 1976)
Al-Banah	53	✓		✓		23.2811	56.9001	Oman	Dhahirah	(de Cardi, Collier, et al. 1976)
Al-Fulayj	CS.1.4	✓		✓		22.8574	58.046	Oman	Sharqiyah	(Deadman 2014; al-Jahwari 2013b: 179)
Al-Ghamlul		✓		✓		22.08	59.35	Oman	Sharqiyah	(al-Jahwari 2013a)
Al-Khashbah	CS.5.8	✓		✓		22.6634	58.0582	Oman	Sharqiyah	(Deadman 2014; al-Jahwari 2013b: 190)
Al-Khawd		✓		✓		23.58	58.12	Oman	Muscat	(Mershen 2002: 99, 103; Frifelt 1975b)
Al-Khutm		✓		✓		23.33	56.65	Oman	Dhahirah	(Cable n.d. 2012)
Al-Menkeb		✓		✓		22.34	59.65	Oman	Sharqiyah	(Giraud 2010)
Al-Qaryatain	CS.4.15	✓		✓		22.8521	57.9684	Oman	Sharqiyah	(al-Jahwari 2013b: 187)
AlQattar		✓		✓		22.23	59.32	Oman	Sharqiyah	(al-Jahwari 2013a)
AlThuwaiqat		✓		✓		22.2	59.25	Oman	Sharqiyah	(al-Jahwari 2013a)
Al-Uqdah		✓		✓		22.13	59.27	Oman	Sharqiyah	(al-Jahwari 2013a)
Ar-Rawdhah	CS.9.3	✓		✓		22.8677	58.22	Oman	Sharqiyah	(al-Jahwari 2013b: 195)
ArRuq		✓		✓		22.19	59.3	Oman	Sharqiyah	(al-Jahwari 2013a)
AsSaih al-Sharqi		✓		✓		22.12	59.28	Oman	Sharqiyah	(al-Jahwari 2013a)
Ba'id	22	✓		✓		23.093	58.3434	Oman	Sharqiyah	(Doe 1977)
Barzaman	CS.7.2	✓		✓		22.3565	58.0606	Oman	Sharqiyah	(al-Jahwari 2013b: 193)
Bat		✓	✓	✓	✓	23.27	56.74	Oman	Dhahirah	(excavation: Böhme 2011; Frifelt 1975a; survey: Gentelle and Frifelt 1989; de Cardi, Collier, et al. 1976; Frifelt 1975b)
Bausher		✓		✓	✓	23.548	58.412	Oman	Muscat	(al-Jahwari and ElMahi 2007)
Bilad Bani Bu Hasan	32	✓		✓		22.1253	59.2733	Oman	Sharqiyah	(Edens 1990; 1987; Doe 1977)
Bisya		✓		✓		22.7425	57.2587	Oman	Dakhiliyah	(Orchard 2000)
Bu Fsheqa		✓		✓		22.26	59.61	Oman	Sharqiyah	(Giraud 2010)
Bu Mdara		✓		✓		22.12	59.6	Oman	Sharqiyah	(Giraud 2010)
Buraimi		✓			✓	24.25	55.82	Oman	Buryami	(During-Caspers 1971)
El-Massawy		✓		✓		22.23	59.42	Oman	Sharqiyah	(Giraud 2010)

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Site Name	Site Code	Tombs	Settlement	Survey	Excavation	Lat	Lon	Country	Area	Reference
Fath	78	✓		✓		22.6321	58.1452	Oman	Sharqiyah	(Doe 1977)
Firq		✓		✓		22.88	57.53	Oman	Dakhiliyah	(Schreiber 2007)
Fiya		✓		✓		22.5	59.6	Oman	Sharqiyah	(Giraud 2010)
Gerran Amr	69	✓		✓		22.5681	58.558	Oman	Sharqiyah	(Doe 1977)
Ghoryeen	CS.2.59	✓		✓	✓	22.875	58.0123	Oman	Sharqiyah	(al-Jahwari 2013b: 212; Deadman 2012b)
Halban		✓		✓		23.58	58.04	Oman	Batinah	(Deadman, Kennet, et al. 2015; Yule and Weisgerber 1998)
Haseed		✓		✓		22.04	59.5	Oman	Sharqiyah	(Giraud 2010)
Hijar		✓		✓	✓	23.23	56.47	Oman	Dhahirah	(Frifelt 1975a)
Hili	8		✓	✓	✓	24.293	55.794	UAE	Abu Dhabi	(Cleuziou 1989a)
Iref		✓		✓		22.29	59.48	Oman	Sharqiyah	(Giraud 2010)
Isma'iyah		✓		✓		22.91	58.88	Oman	Sharqiyah	(Yule and Weisgerber 1998)
Izki		✓		✓		22.92	57.67	Oman	Dakhiliyah	(Schreiber 2004a)
Jabal al Hammah	59, 65, 66	✓		✓		22.4905	58.5833	Oman	Sharqiyah	(Doe 1977)
Jabal al-Emalah		✓		✓	✓	25.04	55.82	UAE	Sharjah	(Potts 2012; Benton and Potts 1994)
Jabal Buhais	BHS	✓		✓	✓	25.01	55.8	UAE	Sharjah	(Jasim 2012; Uerpmann et al. 2006)
Jabal Dhanna		✓		✓	✓	24.1457	52.6338	UAE	Abu Dhabi	(Vogt, Gockel, et al. 1989)
Jabal Handali		✓		✓		22.38	57.47	Oman	Dakhiliyah	(Giraud, Charbonnier, et al. 2012)
Jabal Hafit		✓		✓	✓	24.05	55.8	UAE	Abu Dhabi	(Cleuziou, Vogt, and Méry 2011)
Jabal Haqlah		✓		✓		24.25	55.91	UAE	Abu Dhabi	(Cleuziou, Vogt, and Méry 2011)
Jabal Moudmar		✓		✓		22.46	57.65	Oman	Dakhiliyah	(Giraud, Charbonnier, et al. 2012; Giraud, Mahrooqi, et al. 2010)
Jabal Qara		✓		✓		22.58	57.51	Oman	Dakhiliyah	(Giraud, Charbonnier, et al. 2012; Giraud, Mahrooqi, et al. 2010)
Jabal Salakh		✓		✓		22.41	57.19	Oman	Dakhiliyah	(Giraud, Charbonnier, et al. 2012)
Jahla		✓		✓		22.23	59.52	Oman	Sharqiyah	(Giraud 2010)
Jaltin		✓		✓		22.41	59.46	Oman	Sharqiyah	(Giraud 2010)
Jebel Qard	CS.2.16	✓		✓		22.969	58.0716	Oman	Sharqiyah	(al-Jahwari 2013b: 200)
Jlia		✓		✓		22.16	59.44	Oman	Sharqiyah	(Giraud 2010)
Kalba	K	✓		✓	✓	25.04	56.33	UAE	Sharjah	(Eddisford and Phillips 2009)
Khadra Bani Dafa'a	CS.2.69	✓		✓		22.8314	57.9731	Oman	Sharqiyah	(al-Jahwari 2013b: 215)
Khatam		✓		✓		22.09	59.34	Oman	Sharqiyah	(Giraud 2010)
Khatt		✓		✓		25.6144	56.0097	UAE	RAK	(de Cardi 1985; de Cardi, Kennet, et al. 1994)
Khawr Jarama		✓		✓		22.47	59.72	Oman	Sharqiyah	(Giraud 2010)

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continued

Site Name	Site Code	Tombs	Settlement	Survey	Excavation	Lat	Lon	Country	Area	Reference
Khubayb		✓		✓	✓	23.61	56.18	Oman	Dhahirah	(Williams and Gregoricka 2013)
Khutma		✓		✓		23.51	56.22	Oman	Dhahirah	(Williams and Gregoricka 2013)
Khuwisi	CS.2.8	✓		✓		22.9423	58.0618	Oman	Sharqiyah	(al-Jahwari 2013b: 199)
Kitaitat		✓		✓		22.2	59.3	Oman	Sharqiyah	(al-Jahwari 2013a)
Mahleya	CS.2.42	✓		✓		22.8907	58.0244	Oman	Sharqiyah	(al-Jahwari 2013b: 204)
Malahi		✓		✓		22.3	59.74	Oman	Sharqiyah	(Giraud 2010)
Maqta'ah		✓		✓		22.83	58.99	Oman	Sharqiyah	(Yule and Weisgerber 1998)
Marafass		✓		✓		22.31	59.55	Oman	Sharqiyah	(Giraud 2010)
Maysar	M3, M25	✓		✓	✓	22.8	58.13	Oman	Sharqiyah	(Weisgerber 1980)
Mazyad		✓		✓	✓	24.0334	55.8047	UAE	Abu Dhabi	(Frifelt 1975a)
Naked		✓		✓		22.43	59.52	Oman	Sharqiyah	(Giraud 2010)
Niba'	49	✓		✓		22.733	58.6777	Oman	Sharqiyah	(Doe 1977)
Qarn Bint Sa'ud		✓		✓	✓	24.38	55.72	UAE	Abu Dhabi	(Frifelt 1971)
Qarn Kabsh	55	✓		✓		23.3766	56.7161	Oman	Dhahirah	(de Cardi, Collier, et al. 1976)
Qubur Juhhal	40	✓		✓		23.1375	56.8875	Oman	Dhahirah	(de Cardi, Collier, et al. 1976)
Ra's al-Aysh		✓		✓	✓	24.14	53.16	UAE	Abu Dhabi	(Vogt, Gockel, et al. 1989)
Ra's al-Hadd	HD-10, HD-4	✓	✓	✓	✓	22.53	59.79	Oman	Sharqiyah	(Azzara 2009; Salvatori 2001)
Ra's al-Jinz	RJ-6	✓		✓	✓	22.42	59.83	Oman	Sharqiyah	(Santini 1987a)
Roqum		✓		✓		22.44	59.63	Oman	Sharqiyah	(Giraud 2010)
Rubkah	CS.2.1	✓		✓		23.0021	58.1213	Oman	Sharqiyah	(al-Jahwari 2013b: 198)
Saih alHamar		✓		✓		22.26	59.32	Oman	Sharqiyah	(al-Jahwari 2013a)
Saih Al-Saad		✓		✓		22.17	59.27	Oman	Sharqiyah	(al-Jahwari 2013a)
Saih Bu Qaoud		✓		✓		22.27	59.33	Oman	Sharqiyah	(al-Jahwari 2013a)
Saih Bu Shakhrah		✓		✓		22.26	59.32	Oman	Sharqiyah	(al-Jahwari 2013a)
Saih Buerid	8	✓		✓		23.2403	58.7055	Oman	Muscat	(de Cardi, Collier, et al. 1976)
Saih Huwidfah		✓		✓		22.26	59.33	Oman	Sharqiyah	(al-Jahwari 2013a)
Saih Musaybeikh		✓		✓		22.27	59.34	Oman	Sharqiyah	(al-Jahwari 2013a)
Shabat al-Uood		✓		✓		22.14	59.28	Oman	Sharqiyah	(al-Jahwari 2013a)
Shama		✓		✓		22.53	59.52	Oman	Sharqiyah	(Giraud 2010)
Shariq		✓		✓		22.89	58.9	Oman	Sharqiyah	(Yule and Weisgerber 1998)
Shenah		✓		✓	✓	22.89	58.75	Oman	Sharqiyah	(al-Belushi and ElMahi 2009)
Shir	Shi	✓		✓	✓	22.82	59.06	Oman	Sharqiyah	(Yule and Weisgerber 1998)
Shiya		✓		✓		22.55	59.52	Oman	Sharqiyah	(Giraud 2010)
Siyudian	CS.2.2	✓		✓		23.0261	58.1956	Oman	Sharqiyah	(al-Jahwari 2013b: 198)

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continued

Site Name	Site Code	Tombs	Settlement	Survey	Excavation	Lat	Lon	Country	Area	Reference
Suwayhs		✓		✓		22.03	59.61	Oman	Sharqiyah	(Giraud 2010)
Tawi Amer		✓		✓		22.11	59.31	Oman	Sharqiyah	(al-Jahwari 2013a)
Tawi Silaim		✓		✓	✓	22.54	58.65	Oman	Sharqiyah	(de Cardi, Bell, et al. 1979)
Tiwi		✓		✓		22.83	59.25	Oman	Sharqiyah	(Schreiber and Häser 2004)
’Uyun		✓		✓		22.3565	58.0525	Oman	Sharqiyah	(Deadman 2014)
Wadi al-Fay	3	✓		✓		25.5325	56.1258	UAE	Fujairah	(Brass and Britton 2004)
Wadi al-Khurus	8	✓		✓		25.528	56.1177	UAE	Fujairah	(Brass and Britton 2004)
Wadi al-Qawr		✓		✓		24.91	55.97	UAE	RAK	(Phillips 1997; Doe and de Cardi 1983)
Wadi Bani ’Awf		✓		✓		23.33	57.49	Oman	Batinah	(Häser 2003; 2000)
Wadi Ibra		✓		✓		22.75	58.54	Oman	Sharqiyah	(Schreiber 2005)
Wadi Jizzi		✓		✓		24.308	56.55	Oman	Batinah	(Düring and Olijdam 2015; Frifelt 1975b)
Wadi Sal		✓		✓		22.06	59.55	Oman	Sharqiyah	(Giraud 2010)
Wadi Tal		✓		✓		22.23	59.35	Oman	Sharqiyah	(al-Jahwari 2013a)
Wahrah		✓		✓		23.28	56.7	Oman	Dhahirah	(Cable n.d. 2012)
Zammah		✓		✓		23.22	57.41	Oman	Batinah	(Häser 2000)
Zukayt		✓		✓		22.88	57.74	Oman	Dakhiliyah	(Yule and Weisgerber 1998; de Cardi, Collier, et al. 1976)

total number of Hafit sites = 115; tomb sites = 114; settlement sites = 4

Table A.2: Possible Hafit sites

Site Name	Site Code	Description	Lat	Lon	Country	Area	Reference
Al-Hamra	30	stone cairns	23.107	57.284	Oman	Dakhliyah	(de Cardi, Collier, et al. 1976: 161)
Amlah	41	cairns	23.150	56.903	Oman	Dhahirah	(de Cardi, Collier, et al. 1976: 166–167)
Araqi	62	cairn tombs	23.255	56.572	Oman	Dhahirah	(de Cardi, Collier, et al. 1976: 174–175)
Al-Shab 3	GAS-3	cairns	22.853	59.236	Oman	Sharqiyah	(Biagi 1988: 287)
Al-Shab 7	GAS-7	cairns	22.855	59.233	Oman	Sharqiyah	(Biagi 1988: 287)
Ash-Sham	36	cairn c.6.5m, roughly built of boulders	26.010	56.090	UAE	RAK	(de Cardi 1985: 171)
Bahla	33	circular mound, double stone wall	23.000	57.300	Oman	Dakhliyah	(de Cardi, Collier, et al. 1976: 162)
Bandar Khayran	BK-8	cairns	23.521	58.735	Oman	Muscat	(Biagi 1988: 286)
Bilas Sur	33	numerous cairns	22.545	59.495	Oman	Sharqiyah	(Doe 1977: 47)
Bilal Bani Bu Hasan	32	cairn tombs	22.040	59.330	Oman	Sharqiyah	(Doe 1977: 46–47)
Bir Sayf	24	four cairn tombs	23.016	58.193	Oman	Sharqiyah	(Doe 1977: 46)
Bukha	22c	“beehive” cairns	26.134	56.141	Oman	Musandam	(de Cardi 1975: 42–44)
Dibik	43	probably beehive type	22.629	58.811	Oman	Sharqiyah	(Doe 1977: 48)
Dumm	50	nine low cairns	23.226	57.061	Oman	Dhahirah	(de Cardi, Collier, et al. 1976: 170)
Fawah	10	four tombs, flat stones	23.344	58.629	Oman	Muscat	(Doe 1977: 42–43)
Film 1	1	cairns	20.626	58.190	Oman	Wusta	(Biagi 1988: 289)
Film 2	2	cairns	20.655	58.186	Oman	Wusta	(Biagi 1988: 289)
Ghalilah	4, 37	circular cairn, several cairns, group of cairns	25.996	56.084	UAE	RAK	(de Cardi 1985: 171; de Cardi and Doe 1971: 242–243)
Hajir	9	circular cairn tomb structures	23.175	58.987	Oman	Muscat	(Doe 1977: 41–42)
Hajr	11	eight large cairns	23.488	58.505	Oman	Muscat	(Doe 1977: 43)
Hayli	41	five triple-walled tombs and cairn tombs	22.625	58.817	Oman	Sharqiyah	(Doe 1977: 47–48)
Hindarut	21	cairns	23.126	58.369	Oman	Dakhliyah	(Doe 1977: 44)
Jabal Shamm	10	heaped stones, survey cairn	25.315	56.335	Oman	Sharjah	(de Cardi 1975: 36)
Jabal Wamm	1	82 tombs, beehive tombs?	25.600	56.225	UAE	Fujairah	(Brass and Britton 2004: 157–160)
Jazirat al-Ghanam	1b	seven cairns, roughly oval	26.365	56.359	Oman	Musandam	(de Cardi 1975: 30–34)
Jib	15	small cairns	25.686	56.046	UAE	RAK	(de Cardi and Doe 1971: 252)
Khafifa	12	group of cairn tombs	22.847	58.328	Oman	Sharqiyah	(de Cardi, Collier, et al. 1976: 155)
Khawr Jaramah 18	KJ-18	cairns	22.477	59.736	Oman	Sharqiyah	(Biagi 1988: 288)
Khawr Jaramah 5	KJ-5	cairns	22.520	59.725	Oman	Sharqiyah	(Biagi 1988: 288)
Khutm	57	14 cairn tombs	23.277	56.721	Oman	Dhahirah	(de Cardi, Collier, et al. 1976: 172)
Lasmu	7	four cairns	23.109	58.863	Oman	Muscat	(Doe 1977: 41)
Maayah Pass	35	cairn tombs	22.313	59.294	Oman	Sharqiyah	(Doe 1977: 47)
Mahlah	15	three cairns	22.994	58.603	Oman	Sharqiyah	(Doe 1977: 43)
Maqlab Isthmus	14a	buricairn	26.197	56.399	Oman	Musandam	(de Cardi 1975: 37)
Miskin	54	extensive group of cairns, tombs and graves	23.506	56.861	Oman	Dhahirah	(de Cardi, Collier, et al. 1976: 171)
Misram	23	collapsed circular cairns	23.020	58.267	Oman	Sharqiyah	(Doe 1977: 45–46)
Mizbar	20	cairns	23.145	58.445	Oman	Sharqiyah	(Doe 1977: 44)
Muhya	6	group of cairns	23.165	58.862	Oman	Muscat	(Doe 1977: 41)

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continued

Site Name	Site Code	Description	Lat	Lon	Country	Area	Reference
Musfa	45	ancient cairns	22.900	58.210	Oman	Sharqiyah	(Goettler et al. 1976: 46, plate 10)
Nabiq	70	three cairns on ridges	22.575	58.549	Oman	Sharqiyah	(Doe 1977: 56)
Nigid Busfa	48	stone cairns	22.764	58.699	Oman	Sharqiyah	(Doe 1977: 48–49)
Qabil	11	small cairn tomb	22.563	58.418	Oman	Sharqiyah	(de Cardi, Collier, et al. 1976: 155)
Qabil YBu Said	72	cairns	22.571	58.418	Oman	Sharqiyah	(Doe 1977: 56)
Qalhat 5	QLT-5	cairns	22.752	59.335	Oman	Sharqiyah	(Biagi 1988: 287)
Qurayyah	27	many stone, circular cairns	25.241	56.353	UAE	Fujairah	(de Cardi and Doe 1971: 256)
Qurr Hammam	17	group of cairns	23.112	58.547	Oman	Sharqiyah	(Doe 1977: 43)
Ra’s Madrakah 2	MDK-2	cairns	19.008	57.832	Oman	Wusta	(Biagi 1988: 290)
Ra’s Madrakah 8	MDK-8	cairns	18.975	57.804	Oman	Wusta	(Biagi 1988: 290)
Ra’s Wudayyah 2	WD-2	cairns	22.397	59.820	Oman	Sharqiyah	(Biagi 1988: 288)
Ra’s Wudayyah 3	WD-3	cairns	22.389	59.817	Oman	Sharqiyah	(Biagi 1988: 288)
Rawdah	27	four cairns	23.048	57.430	Oman	Dakhliyah	(de Cardi, Collier, et al. 1976: 160–161)
Sa’a Sidri	1	six circular tombs	23.229	58.665	Oman	Muscat	(de Cardi, Collier, et al. 1976: 151)
Saruq	1	four tomb structures, oval or circular	23.612	58.484	Oman	Muscat	(Doe 1977: 39)
Sawt	12	large cairns	23.041	58.699	Oman	Sharqiyah	(Doe 1977: 43)
Sharbitat 1	SBT-1	cairns	17.932	56.282	Oman	Dhofar	(Biagi 1988: 290)
Sharbitat 2	SBT-2	cairns	17.940	56.259	Oman	Dhofar	(Biagi 1988: 290)
Shawqirah		cairns	18.158	56.535	Oman	Wusta	(Biagi 1988: 290)
Shuwayr 2	SHW-2	cairns	19.496	57.717	Oman	Wusta	(Biagi 1988: 290)
Shuwayr 3	SHW-3	cairns	19.508	57.705	Oman	Wusta	(Biagi 1988: 290)
Shyia	SHI-1	cairns	22.556	59.621	Oman	Sharqiyah	(Biagi 1988: 287)
Siya Haddiya	7	15 graves similar to Sa’a Sidri	23.221	58.684	Oman	Muscat	(de Cardi, Collier, et al. 1976: 153)
Tawi Qarn Kabsh	56	over 16 large cairn tombs	23.376	56.675	Oman	Dhahirah	(de Cardi, Collier, et al. 1976: 171)
Wadi al-Bih	43	roughly conical cairn	25.813	56.110	UAE	RAK	(de Cardi 1985: 181)
Wadi Awsaq	10	isolated oval structure, forms a beehive	25.571	56.044	UAE	Fujairah	(Brass and Britton 2004: 165)
Wadi Ghadun		cairns	18.755	56.739	Oman	Wusta	(Biagi 1988: 290)
Wadi Gharm 1	WG-1	cairns	18.962	57.537	Oman	Wusta	(Biagi 1988: 290)
Wadi Gharm 2	WG-2	cairns	18.948	57.546	Oman	Wusta	(Biagi 1988: 290)
Wadi Haqil	41b	circular boulder cairns	25.802	56.039	UAE	RAK	(de Cardi 1985: 179)
Wadi Haytam 1	1	cairns	18.837	56.905	Oman	Wusta	(Biagi 1988: 290)
Wadi Haytam 2	2	cairns	18.809	56.853	Oman	Wusta	(Biagi 1988: 290)
Wadi Khabb	11	isolated oval structure, beehive tomb?	25.589	56.131	UAE	Fujairah	(Brass and Britton 2004: 166)
Wadi Lisq		cairns	18.691	56.645	Oman	Wusta	(Biagi 1988: 290)
Wadi Mihnah	15	large oval mound, similar smaller cairn	25.534	56.018	UAE	Fujairah	(Brass and Britton 2004: 170)
Wadi Murka	37	cairns	22.437	59.116	Oman	Sharqiyah	(Doe 1977: 47)
Wadi Rahabah	38a	three oval cairns	25.924	56.070	UAE	RAK	(de Cardi 1985: 173)
Wadi Riyamah	35	small circular/oval mounds	25.546	56.055	UAE	Fujairah	(Brass and Britton 2004: 178)
Wihi Murr	34	20 cairns and circular tombs	22.943	57.281	Oman	Dakhliyah	(de Cardi, Collier, et al. 1976: 162)

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continued

Site Name	Site Code	Description	Lat	Lon	Country	Area	Reference
Yani Raja	67	large cairn of river boulders	22.552	58.589	Oman	Sharqiyah	(Doe 1977: 56)
Zahir	40	ten cairns	22.579	58.822	Oman	Sharqiyah	(Doe 1977: 47)
Zibb	22	14 stone cairn tombs	22.933	57.750	Oman	Dakhliyah	(de Cardi, Collier, et al. 1976: 158–159)

total number of possible Hafit sites = 80

A.2 Umm an-Nar sites

The collection of 'Umm an-Nar sites' consists of a single list (Table A.3, Figure A.3). The table includes a 'major site' field that indicates whether each site boasts three or more round-towers, a distinction made between Umm an-Nar settlements as part of GIS analysis (see Chapter 4.5.1).

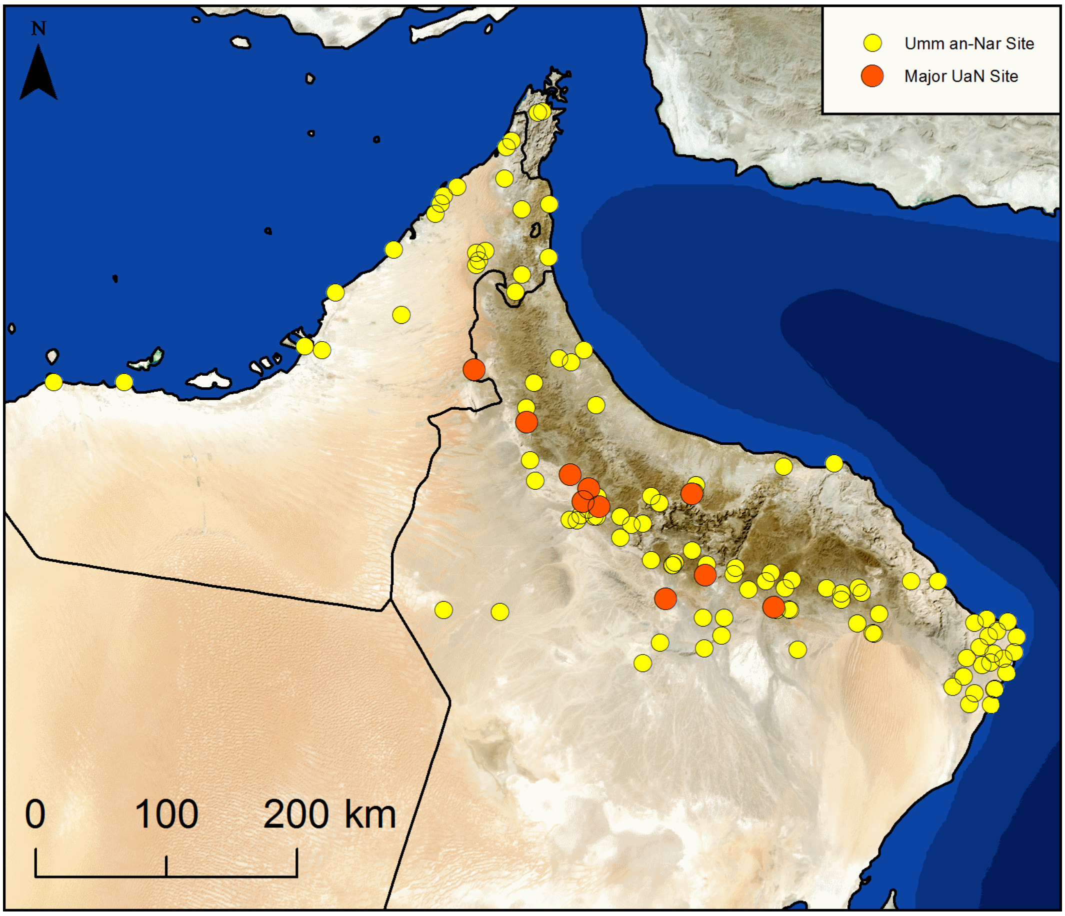

Figure A.3: Map of Umm an-Nar sites

Table A.3: Umm an-Nar sites

Site Name	Site Code	Tombs	Settlement	Major Site	Survey	Excavation	Lat	Lon	Country	Area	Reference
Abu Dhabi Airport	ADA 1; 2; 7		✓		✓	✓	24.412	54.644	UAE	Abu Dhabi	(Beech, Kallweit, and Hellyer 2004; Kallweit 2004; de Cardi 1997)
Ad-Daffah		✓			✓		22.317	59.82	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Ad-Dariz North		✓			✓		23.28	56.72	Oman	Dhahirah	(Cable 2012: 105–116, fig. 33)
Ad-Dariz South	ADS-1; 2	✓	✓		✓		23.29	56.6	Oman	Dhahirah	(Cable 2012: 105–16, fig. 33; Possehl et al. 2011: 44–51; 2009: 26; 2008: 2; Gentelle and Frifelt 1989: 123; Frifelt 1985: 91)
Aflaj		✓			✓		22.3556	58.2158	Oman	Sharqiyah	(de Cardi, Collier, et al. 1976: 156–157)
Ajran			✓		✓		24.0307	56.1876	Oman	Dhahirah	(Cable and Thornton 2013: table 20.1)
Al-Ayn	ALA	✓			✓		22.36	59.564	Oman	Sharqiyah	(Giraud 2010: figure 9; Giraud and Cleuziou 2009: 173; Giraud 2007)
Al-'Ayn	48	✓			✓		23.2221	56.9792	Oman	Dhahirah	(de Cardi, Collier, et al. 1976: 169)
Al-Banah		✓			✓		23.279	56.8954	Oman	Dakhliyah	Manfred Boehme pers. comm.
Al-Hasi	ARS01	✓	✓	✓	✓		23.387	56.62	Oman	Dhahirah	(Kondo, Beuzen-Waller, et al. 2014: 229—231; Kondo, Thornton, et al. 2013: 73, fig. 9.15)
Al-Khubayb		✓			✓		23.6684	56.2169	Oman	Dhahirah	Manfred Boehme pers. comm.
Al-Khutm		✓	✓		✓		23.33	56.65	Oman	Dhahirah	(Kondo, Thornton, et al. 2013: 49–53; Cable 2012: 105–16, fig. 33; Possehl and Thornton 2007: 6—7; de Cardi, Collier, et al. 1976: 172)
Al-Menkeb		✓			✓		22.312	59.665	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Al-Naba		✓			✓		22.7459	58.694	Oman	Sharqiyah	(Böhme and al-Bakri 2012: 156)
Al-Qutainah		✓	✓		✓		22.27	57.061	Oman	Dakhliyah	(Böhme and al-Bakri 2012; Giraud 2008: 8)
Amlah		✓	✓		✓	✓	23.136	56.895	Oman	Dhahirah	(de Cardi, Collier, et al. 1976)
Aqir		✓	✓		✓		22.982	57.1256	Oman	Dakhliyah	(Weisgerber and Yule 2003)
Araqi		✓	✓		✓		23.2553	56.5716	Oman	Dhahirah	(Possehl et al. 2008: 2; Doe 1983: 82–83; de Cardi, Collier, et al. 1976: 174–175)
Asilah	ASL-1		✓		✓		21.96	59.64	Oman	Sharqiyah	(Cleuziou 2003: 137, 146, fig. 2.)
Asimah	As	✓	✓		✓	✓	25.403	56.146	UAE	RAK	(Görsdorf and Vogt 2001; Vogt 1994; de Cardi 1985: 186–191)
As-Safri			✓	✓	✓		23.5736	56.5206	Oman	Dhahirah	(Cable and Thornton 2013: table 20.1)
As-Suwayh		✓			✓		22.07	59.674	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)

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continued

Site Name	Site Code	Tombs	Settlement	Major Site	Survey	Excavation	Lat	Lon	Country	Area	Reference
Bahla/Al-Ghubra	33, BB-6, BB-4	✓	✓		✓	✓	22.964	57.3006	Oman	Dakhliyah	(Munoz, Ghazal, et al. 2012; Munoz and Cleuziou 2008: 628; Cleuziou and Munoz 2007: 304; Orchard and Orchard 2007: 149–151; Weisgerber and Yule 2003: 28; Orchard and Stanger 1994: 82; de Cardi, Collier, et al. 1976: 162; Humphries 1974: 50–52)
Bat		✓	✓	✓	✓	✓	23.35	56.74	Oman	Dhahirah	(Schmidt 2014; 2013; 2012; 2011; 2010; Kondo 2014; Kondo, Thornton, et al. 2013; Thornton et al. 2013; Thornton and Mortimer 2012; Cable 2012; Possehl et al. 2011; 2010; 2009; 2008; Possehl and Thornton 2007; Böhme 2012; 2011; Böhme and al-Sabri 2011; Weisgerber et al. 2008; 2007; Weisgerber, Heckes, and Böhme 2006; Weisgerber, Heckes, Niederhagemann, et al. 2005; Frifelt 2002; 1989; 1985; 1979; 1976; 1975a,b; Gentelle and Frifelt 1989; Brunswig 1989; de Cardi, Collier, et al. 1976)
Batha 1			✓		✓		22.63	58.06	Oman	Sharqiyah	(Hastings et al. 1975: 12, fig. 2)
Batin 1			✓		✓		22.78	58.67	Oman	Sharqiyah	(Hastings et al. 1975: 12, 15, fig. 2)
Bidya			✓		✓	✓	25.437	56.353	UAE	Fujairah	(al-Tikriti 1989a)
Bisya/Salut/Zabi	37–39, BB-15–16, 19–22	✓	✓	✓	✓	✓	22.717	57.233	Oman	Dakhliyah	(Esposti 2013; 2011; Esposti and Phillips 2012; Phillips, Condoluci, et al. 2012; Orchard and Orchard 2007; 2002; Orchard 2000; Orchard and Stanger 1999; Orchard 1995; Orchard and Stanger 1994; Orchard 1985; de Cardi, Collier, et al. 1976; Hastings et al. 1975; Humphries 1974)
Bu Fsheqa		✓			✓		22.252	59.64	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Dahwa		✓	✓		✓	✓	24.05	56.71	Oman	Batinah	Nasser al-Jahwari pers. comm.
Damm		✓			✓		23.2305	57.0645	Oman	Dhahirah	Manfred Boehme pers. comm.
Dhayah		✓			✓		25.8756	56.0626	UAE	RAK	(Kästner 1991: 235)
Falaj al-Qaba'il		✓			✓	✓	24.43	56.62	Oman	Batinah	(Potts 2012: 373; Frifelt 1975b: 375–375)
Falaj ash-Shrah		✓	✓		✓		23.4975	57.462	Oman	Batinah	(Kennet, al-Jahwari, Deadman, Mortimer, et al. 2015; Kennet, al-Jahwari, Deadman, and Mortimer 2014)

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Site Name	Site Code	Tombs	Settlement	Major Site	Survey	Excavation	Lat	Lon	Country	Area	Reference
Fath			✓		✓		22.6338	58.1477	Oman	Sharqiyah	(Cable and Thornton 2013: table 20.1; Weisgerber 1981: 177, 180)
Firq	24, 25		✓	✓	✓		22.88	57.53	Oman	Dakhliyah	(Orchard 2000: 225; Orchard and Stanger 1999: 91; de Cardi, Collier, et al. 1976: 159–60)
Ghanadha					✓	✓	24.81	54.74	UAE	Abu Dhabi	(al-Tikriti 1985)
Ghoryeen		✓	✓		✓	✓	22.8882	58.0191	Oman	Sharqiyah	(al-Jahwari 2013b: 204; al-Jahwari and Kennet 2010)
Hamriya			✓		✓	✓	25.4369	55.5237	UAE	Sharjah	(Magee et al. 2009)
Haseed		✓			✓		22.039	59.521	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Hatta		✓			✓		24.83	56.1	UAE	Dubai	(al-Tikriti 2011: 74–77)
Hayl		✓			✓		24.204	56.246	Oman	Dhahirah	(Frifelt 1975b: 371)
Hijayrmat		✓				✓	23.42	56.7225	Oman	Dhahirah	(Böhme and al-Bakri 2012: 162)
Hili		✓		✓	✓	✓	24.293	55.794	UAE	Abu Dhabi	(McSweeney et al. 2008; Méry and Tengberg 2009; Méry, McSweeney, Roquet, et al. 2008; Méry, McSweeney, Van Der Leeuw, et al. 2004; Cleuziou, Vogt, and Méry 2011; Cleuziou 1989a,b; 1982; 1980; 1979; Cleuziou, Pottier, et al. 1977; Frifelt 1990; 1975b; 1971; 1969)
Hili North		✓			✓	✓	24.294	55.794	UAE	Abu Dhabi	(Cleuziou, Vogt, and Méry 2011; McSweeney et al. 2008; Méry 1997; Cleuziou and Vogt 1985; El-Najjar 1985; Vogt 1985a: 20; Cleuziou and Vogt 1983)
Ibra		✓			✓		22.697	58.54	Oman	Sharqiyah	(Schreiber 2005: 255)
Ibri/Selme		✓			✓		23.2568	56.5192	Oman	Dhahirah	(Yule and Weisgerber 2001: 9–15)
Iref		✓			✓		22.286	59.469	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Izki		✓	✓		✓		22.9239	57.7556	Oman	Dakhliyah	(Schreiber 2004a; Costa 1988b)
Jabal al-Emalah		✓			✓	✓	25.043	55.822	UAE	Sharjah	(Potts 2012; Benton and Potts 1994)
Jabal al-Handali	BHS	✓			✓		22.37	57.52	Oman	Dakhliyah	(Giraud, Charbonnier, et al. 2012; Giraud 2008: 5)
Jabal Buhais		✓			✓	✓	25.0131	55.8018	UAE	Sharjah	(Jasim 2012: 126–127; Uerpmann et al. 2006; Jasim 2003: 88–93)
Jebel Fayh		✓			✓		25.1	55.8	UAE	Sharjah	(al-Tikriti 2011: 74–77)
Jabal Moudmar		✓			✓		22.459	57.649	Oman	Dakhliyah	(Giraud, Charbonnier, et al. 2012; Giraud, Mahrooqi, et al. 2010: 177–178)
Jabal Qara		✓			✓		22.58	57.51	Oman	Dakhliyah	(Giraud, Charbonnier, et al. 2012)

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Site Name	Site Code	Tombs	Settlement	Major Site	Survey	Excavation	Lat	Lon	Country	Area	Reference
Jabal Salakh		✓			✓		22.41	57.19	Oman	Dakhliyah	(Giraud, Charbonnier, et al. 2012)
Jebel Dhanna		✓			✓	✓	24.146	52.634	UAE	Abu Dhabi	(Vogt, Gockel, et al. 1989: 55–56)
Jli'a		✓			✓		22.158	59.44	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Jraw al-Baran		✓			✓		22.234	59.581	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Kalba		✓	✓		✓	✓	25.07	56.35	UAE	Sharjah	(Eddisford and Phillips 2009)
Khadil			✓	✓	✓		23.4741	56.6588	Oman	Dhahirah	(Cable and Thornton 2013: 381, table 20.1)
Khadra Bin Daffa		✓	✓		✓		22.8305	57.9789	Oman	Sharqiyah	(al-Jahwari 2013b: 215)
Khashbah		✓	✓	✓	✓	✓	22.656	58.039	Oman	Sharqiyah	(Schmidt 2015; al-Jahwari 2013b: 189–191; al-Jahwari and Kennet 2010; Weisgerber 1981: 180)
Khatam		✓			✓		22.086	59.359	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Khatt		✓			✓		25.6144	56.0097	UAE	RAK	(de Cardi, Kennet, et al. 1994)
Khawr Jarama		✓			✓		22.466	59.692	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Maidan			✓		✓		23.4219	57.1276	Oman	Batinah	(Cable and Thornton 2013: table 20.1)
Malahi		✓			✓		22.276	59.738	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Maysar		✓	✓		✓	✓	22.78	58.12	Oman	Sharqiyah	(Weisgerber 1981; 1980; 1978: 17; Doe 1977: 46)
Mleiha		✓				✓	25.11	55.87	UAE	Sharjah	(Jasim 2003: 93–98)
Mowaihat		✓	✓		✓	✓	25.364	55.487	UAE	Ajman	(Phillips 2007; Haerinck 1991b; al-Tikriti 1989b)
Munayi		✓			✓	✓	24.95	56.15	UAE	RAK	(Phillips 1997: 207–209)
Muscat		✓			✓		23.62	58.12	Oman	Muscat	(Frifelt 1975b: 389)
Nizwa		✓	✓		✓		22.95	57.54	Oman	Dakhliyah	(Schreiber 2007: 266)
Nud Ziba	16b		✓		✓	✓	22.62	56	UAE	RAK	(Kennet and Velde 1995; de Cardi and Doe 1971: 252)
Qumayra		✓	✓	✓	✓		23.933	56.195	Oman	Dhahirah	(Cable and Thornton 2013: table 20.1; Costa 2006: 143–144, fig. 6; David 2002: 326–327)
Ra's al- Ays		✓			✓	✓	24.16	53.16	UAE	Abu Dhabi	(Vogt, Gockel, et al. 1989: 53–55)
Ra's al-Hadd		✓			✓		22.532	59.778	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Ra's al-Hamra			✓		✓	✓	23.64	58.5	Oman	Muscat	(Santini 1987b: 180)
Ra's al-Jinz	RJ	✓	✓		✓	✓	22.423	59.839	Oman	Sharqiyah	(Munoz, Ghazal, et al. 2012; Giraud 2010: fig. 9; Munoz and Cleuziou 2008; Monchablon et al. 2003; Cleuziou and Tosi 2000)
Rawdah	28, 29		✓		✓		23.0477	57.4299	Oman	Dakhliyah	(de Cardi, Collier, et al. 1976: 160–161)

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Site Name	Site Code	Tombs	Settlement	Major Site	Survey	Excavation	Lat	Lon	Country	Area	Reference
Roqum		✓			✓		22.434	59.63	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Ruways	RWY-2		✓		✓		22.18	59.76	Oman	Sharqiyah	(Cleuziou 2003: 137)
Samad	15	✓			✓	✓	22.8403	58.1758	Oman	Sharqiyah	(de Cardi, Collier, et al. 1976: 156)
Saruq al-Hadid			✓		✓	✓	24.665	55.239	UAE	Dubai	(Herrmann 2013; Herrmann et al. 2012; Casana et al. 2009)
Shama		✓			✓		22.528	59.528	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Shimal		✓			✓	✓	25.831	56.026	UAE	RAK	(Carter 2002; Blau 2001: table 1; Blau and Beech 1999)
Shir		✓			✓	✓	22.819	59.063	Oman	Sharqiyah	(Yule and Weisgerber 1998)
Shiya		✓			✓		22.551	59.618	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Shokur		✓	✓		✓		23.5291	56.2556	Oman	Dhahirah	(Cable and Thornton 2013: table 20.1; Williams and Gregoricka 2013: 137; Williams 2012: 8)
South ed-Dur			✓		✓	✓	25.55	55.65	UAE	UAQ	(Phillips 2007: 5)
Sud		✓			✓		21.965	59.481	Oman	Sharqiyah	(Giraud 2010: figure 9; 2007)
Sufayha			✓		✓		22.9429	57.2866	Oman	Dakhliyah	(Cable and Thornton 2013: table 20.1; Williams and Gregoricka 2013: 137; Williams 2012: 8)
Sufouh		✓				✓	25.1117	55.1733	UAE	Dubai	(Benton 1996)
Sulaymi		✓			✓		22.775	57.851	Oman	Dakhliyah	(de Cardi, Collier, et al. 1976: 158)
Suwayh	SWY		✓		✓	✓	22.066	59.668	Oman	Sharqiyah	(Méry and Marquis 1998; Méry and Charpentier 2002; Biagi 1988: table 1)
Tawi Hulays 1	18		✓		✓		22.46	58.78	Oman	Sharqiyah	(Hastings et al. 1975: 12, fig. 2)
Tawi Sa'id	39		✓		✓	✓	22.4647	58.7706	Oman	Sharqiyah	(de Cardi, Bell, et al. 1979: 84–91; Doe 1977: 47)
Tawi Silaim	51—54	✓			✓	✓	22.536	58.657	Oman	Sharqiyah	(de Cardi, Bell, et al. 1979; Doe 1977: 47)
Tell Abraq		✓	✓		✓	✓	25.4879	55.552	UAE	UAQ	(Magee et al. 2009; Potts 2000; 1993a; 1991; 1990a; 1989; Blau 1996)
Thabiti		✓			✓		22.742	58.54	Oman	Sharqiyah	(Schreiber 2005: 263)
Tikhah	L1000	✓	✓	✓	✓		23.4379	57.4324	Oman	Batinah	(Kennet, al-Jahwari, Deadman, Mortimer, et al. 2015: 14–34)
Tiwi		✓			✓		22.82	59.26	Oman	Sharqiyah	(Schreiber and Häser 2004: 321)
Umm an-Nar		✓			✓	✓	24.438	54.514	UAE	Abu Dhabi	(al-Tikriti 2012; 2011; Frifelt 1995; 1991; 1975b)
Wadi al-Ayn	28	✓			✓		26.0801	56.2939	Oman	Musandam	(de Cardi 1975: 46–47)
Wadi Far 1	19	✓	✓		✓		23.45	57.45	Oman	Batinah	(Hastings et al. 1975: 12, fig. 2)

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Site Name	Site Code	Tombs	Settlement	Major Site	Survey	Excavation	Lat	Lon	Country	Area	Reference
Wadi Halfayn 3	6	✓	✓		✓		22.58	57.67	Oman	Dakhliyah	(Hastings et al. 1975: fig. 2)
Wadi Ibra 2	17	✓	✓		✓		22.63	55.58	Oman	Sharqiyah	(Hastings et al. 1975: 11–12, fig. 2)
Wadi Ithli 4	12	✓	✓		✓		22.63	58.16	Oman	Sharqiyah	(Hastings et al. 1975: 12, fig. 2)
Wadi Khafifah 1	14		✓		✓		22.78	58.43	Oman	Sharqiyah	(Hastings et al. 1975: 12, fig. 2)
Wadi Maqaqah	27b	✓			✓		26.0709	56.261	Oman	Musandam	(de Cardi 1975: 46)
Wahrah		✓	✓		✓		23.28	56.7	Oman	Dhahirah	(Cable and Thornton 2013: table 20.1; Cable 2012: 105–16, fig. 33; Possehl et al. 2008: 2)
Willy		✓			✓		24.3443	56.5213	Oman	Batinah	(Düring and Olijdam 2015; Yule 2001: 408)
Wihi Murr	36		✓		✓		22.9429	57.2811	Oman	Dakhliyah	(de Cardi, Collier, et al. 1976: 163)
Yiqa		✓	✓		✓		23.3757	57.1878	Oman	Batinah	(Kennet, al-Jahwari, Deadman, and Mortimer 2014: 26–30; Cable and Thornton 2013: table 20.1)
Zahir 2-3	16		✓		✓		22.6	58.82	Oman	Sharqiyah	(Hastings et al. 1975: 12, 15, fig. 2)
Zahra			✓		✓		24.371	56.43	Oman	Batinah	(Costa and Wilkinson 1987: 97–98)
Zukait		✓			✓		22.88	57.74	Oman	Dakhliyah	Manfred Boehme pers. comm.

total number of Umm an-Nar sites = 118, major sites = 10, tomb sites = 91, settlement sites = 58

Appendix B

Batinah tomb survey — detailed results

B.1 Batinah Google Earth transect survey

BT-1: Wadi Jizzi

BT-1 contains a significant number of suspected Hafit tombs and LPTs. Three possible Hafit sites and three LPT cemeteries were visited on the ground.

HC-02 is a large cemetery of over 50 reasonably preserved Hafit tombs constructed with wadi cobbles. The structures run along the ridges and slopes of a range of a Quaternary fluvial conglomerate formation that makes up one side of a bowl that runs around a flat gravel plain — other cemeteries are visible on the other side. Two Hafit tombs were recorded at the site: HC-02-1 is a disturbed structure preserved to only 50cm high but with a clear tomb platform, around which lay the collapsed walls; and HC-02-2 which is a quite well preserved tomb with a collapsed roof but surviving walls of ~1m encircling a 1.5m round chamber, and a total diameter of ~4m.

HC-04 is a cemetery of more than 20 wadi cobble Hafit tombs and a single LPT, it is situated within a range of Quaternary fluvial conglomerate hills overlooking the gravel bed and plain of Wadi Suq. The cemetery is close to an old, small quarry for white limestone. Two Hafit tombs were recorded: HC-04-2 is a well preserved Hafit tomb with an intact chamber, but one wall collapsed, that stands to a height of approximately 1.5m and has a diameter of ~5m; HC-04-3 is a very well preserved tomb that stands to a height of ~1.5m with its chamber and roof largely intact, it has a diameter of approximately 5m. The only LPT at the site was also recorded: HC-04-1 is a very well preserved Cell Grave: double wadi cobble walls with a gravel fill, made up of three — or possibly four — conjoined oval chambers with narrow roof entrances, the tomb stands to over a metre in height.

HC-07 is a large cemetery consisting of hundreds of well preserved, wadi cobble Hafit tombs on a range of limestone hills west of Route 7 and south of the village of Magan. Two of the structures were recorded: HC-07-1 is a 4.5m diameter Hafit tomb with part of its chamber wall intact and two concentric ringwalls with packing in-between that is clearly visible; HC-07-2 is a very well preserved structure, 6m in diameter and preserved to a height of ~1.5m, with an oval chamber and 2–3 concentric ringwalls. Suspected 8th century AD green-glazed pottery was found near to the second tomb.

PH-01 was tentatively identified, during the B-GE transect survey, as either a prehistoric cemetery or an abandoned Late Islamic village. On the ground, tucked between two Quaternary conglomerate hills, it proved to be the latter — consisting of a large number of stone house foundations, the base of a possible *sur* and a large area of abandoned fields, all of which were littered with a typical assemblage of Late Islamic cream and red wares, sea shells and some copper finds.

PH-06 consists of a diverse collection of LPTs running along a Hawasina ridge southeast of Route 7. Two of the structures were recorded: PH-06-1 is a well preserved, 3 by 4 metre 'horseshoe' shaped Cell Grave with a central chamber and walls of angular bedrock and a gravel fill; PH-06-2 is a an oval Honeycomb Tomb of at least five chambers built of angular bedrock and a gravel and small stone fill, measuring 10 by 6 metres in total.

PH-09 is a cemetery boasting hundreds of LPTs on a range of hills just south of the village of Majan and to the west of Route 7. Two typical tombs were recorded: PH-09-1 is a single-chambered, 4x3m Cell Grave with a double wadi cobble wall with a gravel fill and an oval entrance in the roof; PH-09-2 is a long, irregular-shaped Cell Grave with six single-chambered parts of various shapes including oval, sub-circular and square/'horseshoe', each with a roof entrance and a double wadi cobble wall with a gravel fill. Near to PH-09-2, and elsewhere in the cemetery, there is what appears to be a Hafit tomb base that has been completely robbed of stone – although it is difficult to be sure of the identification of the tomb due to the condition of the structure.

BT-2: Sohar

BT-2 yielded a significant number of sites during the B-GE transect survey: 8 possible Hafit tomb sites, and one suspected LPT cemetery.

HC-12 stretches across a small range of hills of Quaternary fluvial material and was recorded as a large Hafit cemetery, but when examined on the ground, it was found to contain only single-chambered LPTs. Two typical structures were recorded: HC-12-1 is a sub-circular Cell Grave with an oval entrance at roof level constructed with a double wall of wadi cobbles with a gravel fill and standing to a height of approximately 80 cm; HC-12-2 is also a Cell Grave, but is better preserved with its chamber intact and the structure standing to ~1.2m.

HC-13 is a cemetery consisting of hundreds of well-preserved Hafit tombs stretched across a range of hills that run adjacent to a large wadi channel. Two of the structures were recorded: HC-13-1 is a 5.5m diameter wadi cobble tomb with its chamber mostly intact but one side of walling collapsed; HC-13-2 is very similar but slightly smaller with a 4.5m diameter.

HC-14 was originally recorded as a large Hafit cemetery. However, when examined on the ground, Hafit tombs and single and multi-chambered LPTs were observed, with many of the former robbed of stone to build the latter. The tombs are distributed across a range of hills of Quaternary fluvial deposits. Four tombs — two of each type — were recorded at the site. HC-14-1 is a destroyed Hafit tomb with a diameter of approximately 4m, and with all of the larger stones above the surface robbed out, leaving only the base and some smaller stones. HC-14-3 is similar, but with a slightly smaller diameter at ~3.5m, but the only surviving lowest course of stones at the base of the tomb showing a double wadi cobble wall with a packing of smaller stones in between, and the chamber visible as a collection of fine silt and small stones. HC-14-2 is a single chambered Cell Grave preserved to a height of ~80cm with a double wadi cobble wall with a gravel fill and an oval, roof-level entrance. HC-14-4 is a multi-chambered Cell Grave with three parts showing a similar construction to HC-14-2 conglomerated to form a linear tomb; it is possible that the two outer chambers were later additions onto what was originally a single-chambered tomb.

PH-13 is a considerable distance south of the other cemeteries and consists of two lines of very well preserved single chambered LPTs, on a slightly elevated deposit of Quaternary fluvial material between two major channels of the Wadi Hibi system. Two typical examples of the tombs were recorded: PH-13-1 is a sub-circular (4x3.5m) Cell Grave preserved to a height of 80cm, with a double wadi cobble wall and a gravel fill, and an oval roof entrance; PH-13-2 is also a Cell Grave, but has a more pronounced ovular shape (4.5x3m), and with one side built, or at least surviving, much higher than the other (1.4 versus 0.5m).

BT-3: Saham

The B-GE transect survey of BT-3 yielded a relatively small number of sites: only four possible Hafit cemeteries. Tombs at three of these were recorded during fieldwork undertaken to ground-truth the results.

HC-17 was originally recorded as a small Hafit cemetery. However, in the field this site — located on a small hill of pale Tertiary rock overlooking a gravel plain — was found to contain two LPTs as well as 10 Hafit tombs. Two typical Hafit examples and both of the LPTs were recorded. HC-17-1 is a disturbed Hafit tomb of angular bedrock and an approximate diameter of 4.5m; HC-17-2 is of very similar size and is constructed with the same material, but is in better condition with parts of its walling surviving to a height of 1.2m and other sections collapsed to abut a neighbouring tomb. HC-13-3 is an oval Cell Grave (4.5x3m) preserved to height of ~1m, with a double wall of angular bedrock and a gravel fill, and an ovular entrance accessed from the roof but a collapsed chamber; HC-13-4 is very similar but survives to only 70cm high.

HC-18 is a very small Hafit cemetery on a single, low hillock of pale Tertiary rock outcropping from the surrounding gravel plain. There are only 5 Hafit tombs at the site which are very poorly preserved, as well as scatter of red chert debitage and caramel chert in lower concentrations. Two typical examples were recorded: HC-18-1 is a destroyed Hafit tomb of limestone and chert, with a diameter of 5.5m and with the lowest course of its walls barely visible embedded within a silt platform; HC-18-2 is even more ephemeral with only a 5m diameter silt platform and a small amount of masonry remaining.

HC-19 is a large Hafit cemetery with hundreds of tombs scattered across a range of hills of Tertiary rock, Cretaceous sedimentary material, and Quaternary fluvial deposits. Hundreds of Hafit tombs were observed on the ridges and slopes of these hills, constructed from pale angular bedrock slabs, darkly patinated wadi cobbles, or a combination of the two. Two of the structures were recorded: HC-19-1 is a disturbed Hafit tomb of angular bedrock, 4.5m in diameter with masonry slippage at all sides and a collapsed chamber; HC-19-2 is a 4m tomb in slightly better condition with its outer walls partially surviving in places surrounding its collapsed chamber, both angular bedrock slabs and dark wadi cobbles were used in its construction and it possible that the latter were used to face the tomb.

BT-4: Al-Khaburah

BT-4 is unusual as during the B-GE transect survey all of its hundreds of possible Hafit tombs were found grouped in a single massive cemetery, while no LPT cemeteries were reported. Because of this unusual distribution, during the positive ground-truthing three parts of the cemetery in which tombs were particularly dense were investigated.

HC-20A was thought to consist of a large cluster of Hafit tombs, but in the field it proved to be made up of primarily LPTs as well as a much smaller number of possible robbed-out Hafit tomb bases. The structures are distributed across a range of hills made up of Quaternary fluvial deposits on the western side of a sizeable wadi. Three structures were recorded: two of the LPTs; and the clearest Hafit tomb base. HC-20A-1 is a very well preserved wadi cobble and gravel-fill walled structure with three chambers and two smaller annexes reaching about half of the total preserved height of ~80cm; the three main chambers have oval entrances accessed from the roof and the structures are arranged roughly in the shape of a clover. HC-20A-3 is a small, oval (4x2.5m), single-chambered, very well preserved Cell Grave constructed with a double wadi cobble and gravel-fill wall and an oval entrance built into the roof which stands at a modest height of 40–60cm. HC-20A-2 is a destroyed Hafit tomb, robbed of its stones and surviving only to its lowest course embedded in the surface; it has a diameter of ~4m and was found in close proximity to two LPTs which may have been built from stones robbed from the Hafit structure.

HC-20B was also thought to be a large cluster of Hafit tombs, but in the field although robbed out Hafit tomb bases were observed, the majority of the structures were found to be LPTs. The structures are spread across a low range of hills made up of Quaternary fluvial deposits on the eastern side of a significant wadi channel. Four structures were recorded: two robbed-out Hafit tomb bases and two LPTs. HC-20B-1 is a sub-circular (4.5x3m), single-chambered Cell Grave with a double wadi cobble wall with a gravel fill and an oval entrance built into the roof of the structure which reaches to a height of ~60cm. HC-20B-3 is a double-chambered tomb of mainly gravel construction but with some wadi cobbles apparent in the outer walls and the two oval chamber entrances; the two chambers are arranged in a line forming a total structure that is 6.5x2.5m. HC-20B-2 is a very disturbed Hafit tomb of wadi cobbles, with the masonry completely collapsed around a silted, circular chamber HC-20B-4 is a destroyed Hafit tomb neighbouring an LPT; it is preserved to only its lowest course of wadi cobbles, but the construction of much of its 4m diameter structure is apparent with two ringwalls with small stone packing, and a circular silted chamber.

HC-20C was thought to be a modest cluster of Hafit tombs, but in the field it proved to contain a majority of LPTs with a smaller number of robbed and destroyed Hafit tombs. The ~40 tombs are spread across a small range of hills of Quaternary fluvial deposits on the eastern side of a large wadi channel. Two destroyed Hafit tombs and two LPTs were recorded. HC-20C-1 is a sub-circular (4x3.5m), single-chambered Cell Grave with a double wadi cobble wall with gravel packing, preserved to a height of ~60cm and with an oval entrance in the roof of the structure. HC-20C-3 is a very well preserved, single-chambered, wadi cobble and gravel, oval (3.5x2.5m) Cell Grave with an oval entrance set into its collapsed roof. HC-20C-2 is a very disturbed Hafit tomb with a 5m diameter, preserved to a height of ~80cm, in places a double ring-wall is apparent, but most of the tomb's masonry is *in situ* but collapsed. HC-20C-4 is a destroyed Hafit tomb with the larger wadi cobbles robbed out leaving only smaller stones and the lowest course embedded in the surface; the diameter of the tomb is 4.5m and the double ring-walled structure with a small-stone packing is apparent in places, surrounding a silted circular chamber.

BT-5: Al-Suwayq

BT-5 contained the largest number of possible Hafit tombs of any of the transects during the B-GE transect survey. Three Hafit cemeteries were examined in the field, and visual confirmation of the presence of tombs was sought for a further three sites.

HC-22 is a huge Hafit cemetery contains many hundreds of tombs across a large hilly area of Quaternary fluvial deposits, as well as smaller areas of Tertiary sedimentary rock, which is penetrated by numerous sizeable wadi channels. The Hafit tombs are well preserved and constructed from darkly patinated wadi cobbles, pale angular bedrock or a contrasting combination of the two. Two Hafit tombs were recorded: HC-22-1 is a well preserved structure of wadi cobbles with a 4m diameter and boasting sections of a surviving ring wall; HC-22-2 is quite well preserved, 4m in diameter, constructed from both dark wadi cobbles and white angular bedrock, with walls partially intact and preserved to a height of ~80cm.

HC-24 is a small cemetery of ~20 Hafit tombs, distributed across a number of low hillocks of pale Tertiary sedimentary rock which is surrounded by Quaternary fluvial deposits. The disturbed structures use some pale angular bedrock as well as much darker wadi cobbles. Two tombs were recorded: HC-24-1 is a disturbed, 4.5 diameter, wadi cobble Hafit tomb with its walls partially preserved; HC-24-2 is a poorly preserved, 4m Hafit tomb built of dark wadi cobbles on a contrasting white hill of the Tertiary bedrock that has part of its ring wall surviving but generally is severely collapsed.

HC-25 is a large cemetery of hundreds of Hafit tombs, centred on an outcrop of pale Tertiary sedimentary rock, but also stretching away in both directions on hills of Quaternary fluvial material that run adjacent to a large wadi channel. The Hafit tombs are mostly in poor condition although some are much better preserved, and are built of darkly patinated wadi cobbles, but also make some use of slabs of white angular bedrock that provide a stark contrast. Two quite well preserved examples were recorded. HC-25-1 is a 4m Hafit tomb, well preserved to a height up to 1m and constructed from wadi cobbles; the round chamber is visible, but the roof has collapsed into it. HC-25-2 is 4.5m in diameter and is preserved to ~1.5m in height, with its chamber and outer walls in good condition in places; it is constructed from wadi cobbles.

BT-6: Al-Mussanah/Rustaq

BT-6 boasts a large number of possible Hafit cemeteries — 11 were mapped during the B-GE transect survey — as well as two possible LPT sites. Three of the densest Hafit cemeteries and both of the suspected LPT sites were examined in the field.

HC-35 is a collection of Hafit tombs, many badly disturbed, scattered across a range of tall ophiolite hills. The tombs are constructed from angular sections of bedrock, with the best preserved structures found in the most elevated areas. Two typical examples were recorded: HC-35-1 is a very badly disturbed tomb of angular bedrock with only its central platform of silt and embedded masonry surrounded by collapsed walling stones remaining; HC-35-2 is very similar. The diameter of both is hard to gauge because of the preservation of the structures, but originally both were probably between 4 and 5m in diameter.

HC-36 was originally recorded as a sizeable Hafit cemetery, but in the field it proved to contain both disturbed Hafit tombs and much better LPTs. The tombs are sprawled across a range of hills made up of a formation of Hawasina material, ophiolite and Quaternary fluvial deposits. Two tombs of each type were recorded. HC-36-1 is a four-chambered Cell Grave with a double wadi cobble wall with a gravel fill; each structure is of a different size but all are ovular with a roughly central roof entrance. HC-36-2 is an oval (5x3m), single-chambered Cell Grave constructed with double wadi cobble walls and a gravel fill and an ovular entrance in the centre of the roof. HC-36-3 and HC-36-4 are both disturbed Hafit tombs constructed from a combination of angular bedrock and wadi cobbles with a diameter of ~5m.

HC-38 is a sizeable cemetery of over a hundred Hafit tombs distributed across a large range of low hills adjacent to a substantial wadi channel. The hills are made up of Quaternary fluvial deposits and the tombs are constructed from wadi cobbles. Two typical structures were recorded: HC-38-1 is a disturbed Hafit tomb of ~5m diameter with walls collapsed around a clear silt platform; HC-38-2 is better preserved, to a height of ~1m, and is constructed from both wadi cobbles and slabs of angular bedrock, the shape of the chamber is apparent although the roof has collapsed.

PH-16 is an LPT cemetery of ~12 tombs on a single, long hill of Quaternary fluvial material. Both single and multiple-chambered LPTs are present; two typical examples were recorded. PH-16-1 is a massive, roughly oblong Honeycomb Tomb of low-lying cells of wadi cobbles and gravel, forming a 9 'chambered' structure of 17 by 5m. PH-16-2 is of a similar construction but has only 3 cells merged to form a rough circle 6m in diameter. These tombs only reach approximately half a metre in height and show no sign of originally being much taller.

PH-17 is an LPT cemetery of more than ten tombs on a high, flat ridge of Hawasina material. There are a variety of single and multi-chambered wadi cobble tombs; two examples were recorded. PH-17-1 is a well-preserved, single-chambered, oval Cell Grave (4x3m) with a double wadi cobble wall with a gravel fill encircling an elongated oval roof entrance leading into a corbelled chamber. PH-17-2 is a massive Honeycomb Tomb of ~fifteen single-chambered structures forming a massive structure measuring 20x10m. Each part is constructed of a combination of wadi cobbles of varying sizes.

B.2 Full Batinah Google Earth survey

During ground-truthing fieldwork to test the reliability of the final B-GE dataset in distinguishing Hafit tombs from LPTs 34 sites were visited — 18 Hafit and 16 LPT cemeteries — and 66 tombs were recorded — 36 Hafit and 30 LPTs. The complete site notes are presented below.

Hafit tomb sites

In total, 18 suspected Hafit tomb sites were visited in order to test the accuracy of the dating of the 12 arcsecond phase of the B-GE survey. A map of the sites and some selected photos and plans of the tombs are included in the main text of the thesis (Chapter 5.3.2).

H-02 consists of a small group of 15–20 destroyed tombs distributed across a low terrace of Quaternary fluvial material overlooking a small wadi. Two typical structures were recorded. Tomb 1 is a completely robbed tomb base measuring 5.5x5.3m, in which only the lowest courses of two concentric wadi cobble walls survives to a height of 30cm. The only finds observed were a number of sherds of a coarse Late Islamic redware. It was impossible to interpret the original form of the structure, and although it could have been the remains of a Hafit tomb, it was impossible to tell for sure. Tomb 2 is a very similar, but has three concentric ringwalls and is slightly smaller (4.7x4.4m). It also yielded sherds of the same pottery, and although likewise cannot be dated or categorised with certainty, does bare some resemblance to a wadi cobble Hafit tomb excavated in ash-Sharqiyah (al-Jahwari 2010).

H-03 consists of a small group of fewer than ten Hafit tombs distributed across a rocky ridge making up part of a range of tall ophiolite hills. The first typical tomb recorded is a very well preserved Hafit funerary structure constructed with angular bedrock slabs. It is of medium size (~4.5m), and stands to a height of 1.6m with its chamber in tact and the roof partially surviving. No entrance was visible and no surface finds were observed. Tomb 2 is very similar, but is much larger being over 8.5m in diameter, it is also in better condition, surviving to ~2.5m high and being clearly made up of 3 concentric ringwalls that almost close at the top, with one of three roofing slabs still in situ.

H-04 consists of a small group of ~5 badly disturbed tombs running along a low/medium height terrace of Quaternary fluvial material overlooking a sizeable wadi channel. Tomb 1 is a very badly disturbed and stone-robbed structure of wadi cobbles; it is roughly circular (4.6m) and consists of three concentric ringwalls surrounding a central area of loose rocks and silt, it is preserved only to a height of 80cm. No finds were found in proximity to the structure, and although its form could be interpreted as the remains of a robbed-out wadi cobble Hafit tomb, it is impossible to classify the structure with confidence. Tomb 2 is almost identical, but is slightly larger and sub-circular (5x4.7m).

H-06 consists of a small group of 15–20 badly preserved Hafit tombs distributed across a tall outcrop of Tertiary rock. Tomb 1 is a badly disturbed circular structure with a diameter of ~4.4m, constructed from wadi cobbles and angular bedrock slabs; its roof and chamber are totally collapsed, although some sections of walling still survive, and it is preserved to a height of slightly less than 1m. As well as some sherds of Late Islamic coarse redware, some pieces of chipped red chert were also observed in the area of the tomb. Tomb 2 is very similar, with only short sections of wall and the tomb platform remaining other than the collapsed masonry of angular bedrock from which it was constructed. It is ~4.7m in diameter, survives to a height of 70cm and no finds were found in its vicinity.

H-08 is made up of a cluster of ~5 Hafit tombs on a low ridge that forms part of a cemetery of hundreds of structures distributed across a range of hills formed of Quaternary fluvial deposits that overlook a sizeable wadi bed. Tomb 1 is a disturbed Hafit tomb of broken and whole wadi cobbles, ~5m in diameter, that has a totally collapsed roof and chamber, with the entire structure surviving to a height of 1.2m. Tomb 2 is also a Hafit tomb but is smaller (~3m diameter) and better preserved, with an intact sub-circular chamber but a collapsed roof; it survives to a height of 1.3m. No surface finds were visible at the site.

H-09 consists of a small group of ~10 badly disturbed Hafit tombs on a rocky Tertiary hill that outcrops through a wadi plain; other similar tombs are visible on nearby hills. Tomb 1 is a very disturbed probable Hafit tomb with a diameter of 4.6m, it is constructed from wadi cobbles, and although the roof is destroyed, the sub-circular shape of the chamber is just visible (1.6x1.4m). The tomb is preserved to a height of 90cm. Tomb 2 is very badly disturbed probable Hafit tomb, with a large volume of angular white bedrock slabs and darkly patinated wadi cobbles; the roof, chamber and walls are almost completely destroyed, but a platform of silt and stone remains preserved to a height of approximately half a metre. No surface finds were observed around either tomb.

H-10 is made up of a small group of 15–20 Hafit tombs on the base, slopes and ridge of a hill made up of Quaternary fluvial material; many other tombs are visible in the same range of hills[1]. Tomb 1 is a quite well preserved Hafit tomb of mainly wadi cobbles with some inclusions of buff sandstone slabs; the structure is 4.6m in diameter, and is preserved to a height of 1.2m with a partially intact sub-circular chamber (1.9x1.7m) but a collapsed roof. Tomb 2 is very similar but is slightly smaller at 4.1m in diameter. No surface finds were visible at the site.

[1]H-10 forms part of the site of al-Buyraq investigated during the Desert Surface Survey (Chapter 7)

H-12 consists of a large group of ~50 Hafit tombs distributed across a tall hill of Quaternary fluvial material overlooking a wadi plain; a large number of tombs are visible on other nearby hills. Tomb 1 is a disturbed Hafit tomb of mainly wadi cobbles with some angular bedrock slabs, with a diameter of ~5.8m. The roof of the tomb is completely collapsed, but the chamber is partially intact with much of the large volume of fallen masonry slumped to one side; the structure is preserved to a height of 1.1m. The only possible finds apparent near the tomb was some pieces of unworked red chert. Tomb 2 is a very similar structure, but is slightly smaller with a diameter of 4.4m; its chamber is in better condition, with much of the structure's fallen masonry located outside of the walls to one side.

H-13 is situated on a medium-height terrace of Quaternary fluvial material overlooking a large wadi channel and an extensive area of Quaternary aeolian deposits, and is made up of a sizeable group of 20–30 badly disturbed Hafit tombs. Other similar structures are visible on another nearby terrace and Tertiary rock outcrops nearby. Tomb 1 is a disturbed probable Hafit tomb; it is a circular structure with a diameter of 5.2m, with some wall sections on one side preserved to a height of 1m, but most of the walls, the roof and the chamber are entirely collapsed leaving a large volume of wadi cobbles and angular bedrock masonry. Tomb 2 is a disturbed Hafit tomb constructed from similar material, it is slightly smaller in diameter at 4.7m, but is more evenly preserved to a height of 1.1m, although its roof and chamber are collapsed. No surface finds were observed in or around the tombs.

H-15 consists of a sizeable group of ~50 disturbed Hafit tombs situated on a Quaternary fluvial terrace overlooking a large wadi channel and near to a large Tertiary rock outcrop; there are many similar structures on other nearby ridges. Tomb 1 is a probable robbed Hafit tomb — possibly a later transitional structure — that is constructed from unworked angular masonry, is 5.7m in diameter and has a circular chamber; it is only preserved to a height of 40cm. The only surface finds apparent on the tomb were some 20th century porcelain. Tomb 2 is almost identical, although it is slightly better preserved, surviving to a height of 80cm, has a slightly smaller diameter of 5.5m, and yielded no surface finds.

H-17 is located on a very tall terrace of Quaternary fluvial material adjacent to a large wadi channel and consists of a cluster of ~10 Hafit tombs that make up part of a much larger cemetery of several hundred structure distributed on the hills either side of the wadi. Tomb 1 is a badly disturbed probable Hafit tomb, it is built from wadi cobbles, boasts a diameter of 5.5m, and is preserved to a heigh of 90cm on one side; much of the original structure has collapsed leaving a large volume of slumped masonry on all sides. Some possibly worked caramel-coloured chert was found nearby. Tomb 2 is a unique structure that was probably originally a Hafit tomb similar to Tomb 1, that had been remodelled in a later period. It has a low platform of silt and wadi cobbles — probably from the original tomb — that is over 6m in diameter, on which has been built an oval 'long barrow' of wadi cobbles that is 1.4m high, 6.4m long and 4.7m wide. No surface finds were observed in or around the tomb.

H-18 consists of a sizeable group of 20–30 Hafit tombs on the lower slopes of a tall range of hills of Quaternary fluvial deposits and forms part of a large cemetery of similar structures distributed across these hills. The site is protected by a nearby Ministry of Heritage and Culture sign. Tomb 1 is a disturbed probable Hafit tomb of wadi cobbles that is ~4m in diameter and preserved to a height of ~70cm. The roof, chamber, and much of the walling has collapsed forming a large volume of slumped masonry surrounding the structure. A number of sherds of Late Islamic coarse redware were found near to the tomb as well as some possibly worked fragments of chert. Tomb 2 is a similar structure but is much better preserved, with walls and intact chamber surviving to a height of 1.5m; it is 5.5m in diameter. No finds were observed in the vicinity of this tomb.

H-19 is a small group of 10 Hafit tombs, as well as a smaller number of Cell Graves, on a low terrace of Quaternary fluvial material adjacent to a large wadi channel, that forms part of a larger cemetery of structures on other nearby high-ground. Tomb 1 is a very well preserved Hafit tomb of wadi cobbles and angular bedrock that survives to a height of ~2m. Although most of the roof has collapsed, the walls and chamber are largely in tact, as is a corbelled entrance with a capstone on the north-west side of the structure; the tomb is ~7.5m in diameter. A number of pieces of possibly worked red chert were found around the structure. In contrast, tomb 2 is very badly disturbed — much of its masonry has been robbed leaving a low, 80cm high platform of silt and wadi cobbles, 4.3m in diameter, and surrounded by tumbled masonry. It is likely that the stones were robbed during the construction of two nearby cell graves. A possible lithic tool of red chert was found near to the tomb as well as other pieces of possibly worked red and caramel chert.

H-20 is a group of ~20 Hafit tombs that makes up part of a large, divided cemetery of hundreds of Hafit tombs and LPTs on a long, tall series of rocky ridges of material from Cretaceous deposits of the Arabian shelf facies. The site is protected by a Ministry of Heritage and Culture sign. Tomb 1 is a badly disturbed probable Hafit tomb of wadi cobbles that is ~4m in diameter. The structure's roof, chamber and much of its walls are destroyed, but the original shape of the structure remains visible in the remains that stand to a height of 1m, which are surrounded by fallen masonry on every side. No surface finds were observed. Tomb 2 is a very similar structure, but also includes pale buff angular bedrock slabs within its construction as well as the darkly patinated wadi cobbles.

H-21 consists of a group of 20–30 Hafit tombs on a tall rocky hill that lies between the ophiolite hills and lower Quaternary fluvial terraces. Tomb 1 is a very well preserved Hafit tomb, 5.6m in diameter and constructed from angular bedrock slabs. The roof of the structure has collapsed, but the corbelled walls and chamber are largely intact, standing to a height of 1.8m. No finds were observed in or around the tomb. Tomb 2 is a very similar structure, but is slightly smaller with a diameter of 5.1m, and has an entrance preserved on its south-south-eastern side.

H-22 is a sparsely distributed, small group of ~10 Hafit tombs that run along the flat top of a tall hill of Quaternary fluvial material; other similar tombs are visible on other hills in the same range. Tomb 1 is a Hafit tomb of wadi cobbles that is quite well preserved to a height of 1.3m. It has a diameter of 5.6m and a thick double wall that surrounds an oval or sub-circular chamber into which the roof has collapsed. No surface finds were observed. Tomb 2 is a very similar tomb that is slightly largely with a diameter of 5.9m, but which has been remodelled, probably in a later period to form three shallow 1m-long chambers out of the loose masonry that has collapsed into the original single chamber. Some pieces of red and grey chert that could be anthropogenic were found nearby.

H-23 consists of a lone pair of Hafit tombs on a low terrace of Quaternary fluvial material, overlooking a wadi running through a range of ophiolite hills. Tombs 1 and 2 are found in very close proximity, and are effectively conjoined by the tumble of fallen masonry that surrounds them. They are both small structures of wadi cobbles, 3.5m in diameter and have completely collapsed roofs, although the shape of their circular chambers are still apparent. Both structures survive to a height of just over 1m.

H-24 is a low hill of Quaternary fluvial material overlooking a wadi channel that boasts a small cluster of Hafit tombs. Tomb 1 is a quite well preserved Hafit tomb of wadi cobbles with a diameter of 5.4m. Although its roof has collapsed, its chamber and walls are largely intact; a recent survey cairn has been constructed on one side of the tomb. As well as some sherds of Late Islamic coarse redware, some possibly worked red chert pieces were found in close proximity to the tomb as well as some flakes of fine-grained orange/grey chert. Tomb 2 is a similar structure but is larger, with a diameter of 6.9m, and is in even better condition, with walls and chamber surviving to a height of 1.8m. Pieces of chert were also found in the vicinity of this tomb.

Later Prehistoric Tomb (LPT) sites

As part of the ground-truthing fieldwork, 16 suspected LPT sites suspected were examined in the field. For a map of the sites and selected photos and plans, see the main text (Chapter 5.3.2).

P-03 consists of a small group of Hafit tombs that were later drastically remodelled as a LPT cemetery — new Cell Graves were added and the Hafit tombs were extended and altered; the tombs are located on a tall ophiliote hill. Tomb 1 is a disturbed oval Cell Grave (3.8x2.8m) constructed from sections of angular bedrock that form a double wall with a packing of smaller stones that stands to a height of 1m. The roof has collapsed into the chamber, including some long stones that may originally have bridged the oval roof entrance. Tomb 2 was originally a small Hafit tomb of angular stones that has been remodelled, with an extra chamber added to one side. An entrance was made in the roof of the Hafit tomb and parts of the structure were covered with gravel and small stones. The later chamber is very similar to a Cell Grave, being oval in shape (3.4x2.5m) and boasting a double wall of angular stones with a packing of small stones and gravel that survives to a height of 80cm. The roof of the annex has collapsed into the chamber. Sherds of a coarse Late Islamic redware were found around both tombs.

P-06 is an extensive cemetery of more than one hundred diverse LPTs on an ophiolite and Quaternary fluvial terrace overlooking Wadi al-Hoqain[2]. Tomb 1 is a circular Wadi Suq tomb consisting of an outer wall of large wadi cobbles and an oval chamber visible in the centre with the intervening space filled with gravel. The tomb is 4.3m in diameter and stands 90cm high, it is clearly of a very different type to a Cell Grave. Tomb 2 is a second circular Wadi Suq tomb but of different construction, it has a two concentric walls of a single course of wadi cobbles that stand only to a height of 30cm, with the intervening space filled with gravel. The tomb is 3.8m in diameter. No surface finds were observed at the site.

P-07 consists of 50–60 walled platforms built into the sloping ground of a narrow gully cutting through a terrace of Quaternary fluvial material; more structures are visible on the opposite bank of the gully. The structures are sub-circular to oblong in shape and are constructed from wadi cobbles, a typical example is 3x3m in size, with internal dimensions of 1.3x1.3m, and reaches a maximum height of only 30cm. It is unclear

[2]the cemetery has been recorded by the *Rustaq-Batinah Archaeological Survey* project (Kennet, al-Jahwari, Deadman, and Mortimer 2014: 16–17; Kennet, al-Jahwari, Deadman, Mortimer, et al. 2015: 88)

whether they are funerary monuments or serve a completely different purpose — surface finds of a coarse Late Islamic redware may suggest that they relate to recent settlement, although they are too small to be domestic structures.

P-09 is group of ~10 single and multiple-chambered LPTs located on a small terrace of Quaternary fluvial material surrounded by aeolian sand deposits on two sides and two very large wadi beds. Tomb 1 is an oval Cell Grave with a double wadi cobble wall with small stone and gravel packing that surrounds an oval chamber and is preserved to a height of 80cm. The roof of the tomb appears to have been removed, leaving sand to fill the chamber. Some pieces of red chert were found around the structure. Tomb 2 is a very similar structure but is more sub-circular than oval in shape, smaller in size (2.9x2.8x0.7m), and yielded no surface finds.

P-10 consists of a group of 25–30 LPTs situated on a low terrace of Quaternary fluvial material. Tomb 1 is an oval Cell Grave (4.8x3.7m) constructed from wadi cobbles and angular sections of Tertiary bedrock that are formed into a double wall, with a small stone and gravel packing, that stands to a height of 80cm. The roof has completely collapsed into the oval chamber. Some sherds of Late Islamic coarse redware and chocolate-chip were found in the vicinity of the structure. Tomb 2 is very a similar structure but is smaller (3.9x2.9x0.7m) and yielded no surface finds.

P-11 is a group of 10–15 tombs on a medium-height hill of Quaternary fluvial material overlying ophiolite which outcrops in places; the hill is adjacent to a large wadi channel with a Late Islamic *sur* and a modern settlement and farms nearby. Tomb 1 is a completely destroyed tomb that has been cleared into a ring of pieces of angular masonry (6.8m diameter), leaving a silt and rock platform in the centre. It is possible that is was adapted into a *sangar* to protect the nearby settlement as the hill overlooks the wadi and a pass into the valley. Tomb 2 is a sub-circular Cell Grave (4.6x4.2m) of angular and sub-angular masonry with a double wall with small stone packing standing to a height of 90cm surrounding a preserved chamber. Most of the roof has collapsed into the chamber but a single roofing slab remains in situ. Sherds of very coarse Iron Age II redware were found in close proximity to Tomb 2, as well as some fine orange pottery with a red slip that probably dates to the 3rd or 2nd millennia BC.

P-12 consists of ~10 LPTs grouped into two clusters on a low Quaternary fluvial terrace adjacent to a small wadi channel and a Tertiary rocky outcrop. Tomb 1 is probably a low, oval Cell Grave (4.3x3.8m), but is covered with a large volume of gravel that is mounded to a height of 60cm, rather than being just used as a packing between walls, with wadi cobbles and angular bedrock slabs acting as retaining walls for this material. The roof has collapsed into the oval chamber. Tomb 2 is a similar structure of similar dimensions (4.4x3.5m), but the chamber is less well preserved while the outer wall is in better condition; white Tertiary bedrock has been clearly been chosen to contrast the darkly patinated wadi cobbles. No surface finds were observed around either tomb.

P-13 is a group of 20–30 LPTs, arranged in distinct clusters and located on a low Quaternary fluvial terrace and a small, taller Tertiary rocky outcrop at the confluence of a large wadi channel and a smaller tributary. Tomb 1 is a badly disturbed structure on the Tertiary rock outcrop that may originally have been a Cell Grave or a small Honeycomb Tomb; it has three sub-circular chambers of ~3.5m diameter, arranged in a curved to form a structure 8x7.5m in total, with the best preserved chamber standing to a height of 70cm. The tomb is constructed from angular sections of the Tertiary bedrock, with smaller stones used as cover and packing material. Tomb 2 is situated on the lower fluvial terrace, and is a disturbed, single-chambered, oval Cell Grave (3.5x3m), with a wadi cobble double wall with gravel packing that is preserved to a height of 80cm. The tomb's corbelled chamber is partially preserved, but the roof is either collapsed or has been removed. No surface finds were observed at the site.

P-14 consists of a small group of ~10 LPTs located on a medium-height conglomerate terrace adjacent to a small wadi channel. Tomb 1 is a low, oval Cell Grave (5.1x3.9x0.6m) with a double wadi cobble wall with a small stone/gravel packing. The structure is disturbed with a collapsed roof, and one side has partially eroded down the slope of the hill. No surface finds were observed. Tomb 2 is a similar tomb, but is in much better condition and is smaller (3.8x2.4x1m).

P-18 is a lone tomb on a low terrace of Quaternary fluvial deposits and forms part of a larger cemetery of similar tombs within the same range of lows hills. Tomb 1 (of 1) is a disturbed, low, double-chambered Cell Grave with wadi cobble walls with a gravel packing. The two chambers share a central wall, but one is in much better condition than the other which has collapsed. Individually the two sections are ovals ~3.5x2.7m in size, and are conjoined to produce a larger structure (5.4x3.5m), that stands ~80cm high in places. No finds were observed in or around the tomb.

P-19 is a cluster of 10–20 LPTs located on a low Quaternary fluvial terrace overlooking a sizeable wadi channel. Tomb 1 is a well-preserved, typical oval Cell Grave (4.4x2.7m), with a double wadi cobble wall with oval packing that stands to a height of ~80cm. Tomb

2 is very similar, but is slightly smaller (3.7x2.6x0.7m), and unusually is oriented north-south rather than east-west. A diverse assemblage of Late Islamic sherds were apparent in the immediate vicinity of both tombs, as well as Iron Age II pottery, fine red chert and the remains of copper furnace lining.

P-20 consists of a small cluster of LPTs that form part of a much larger cemetery of hundreds of tombs distributed across a terrace of Quaternary fluvial material. Tomb 1 is a disturbed double-chambered tomb of wadi cobbles. The nature of its construction and original form are unclear, although double walling and gravel packing are visible in places. It is possible that it is a disturbed Cell Grave, or a poorly preserved Honeycomb Tomb. The structure is 7.1x4.6m in size and in places stands to a height of ~1m; no finds were observed in the vicinity. Similarly, tomb 2 is a disturbed 4–5 chambered tomb, in which the 'chambers' are barely distinguishable from the walls; double-walling with gravel packing is visible in places, but the precise form of the tomb is difficult to interpret. The structure's total dimensions are 10.8x3.6x1m.

P-21 is a group of ~10 LPTs located on the flat top of very tall conglomerate hill that includes very well preserved examples of single and multiple-chambered Cell Graves. The site lies within the boundaries of a municipal 'Solid Waste Disposal Site' — a huge dump for construction and industrial waste. Tomb 1 is a near-complete, typical, oval Cell Grave (5x3m) constructed with a double wall of wadi cobbles with a gravel packing. Although the roof is mostly collapsed, one slab remains in situ lying over the oval, roof-level entrance; the structure stands to the remarkable height of 1.4m. No finds were observed around the tomb. Tomb 2 is in even superior condition and is near-perfect. It is very similar, but is slightly smaller (3.7x2.7x1.4m), and its roof is only half collapsed — half of the roofing slabs remain in situ and covered with a layer of gravel that continues from the 'packing' of the double wall.

P-22 is a cluster of LPTs halfway up a conglomerate terrace across which are distributed hundreds of similar structures. The site is protected by a Ministry of Heritage and Culture sign. Tomb 1 is a well preserved, single-chambered oval Cell Grave (4.6x3.2m) with a double wall of wadi cobbles with a small stone/gravel packing enclosing a partially collapsed oval chamber. The best preserved walls stand to a height of 80cm. Tomb 2 is very similar, but is in better condition — the chamber is completely intact, although the roof has collapsed, and the structure stands to a height of 1m.

P-24 consists of a sizeable group of 20–30 tombs that form part of a large, diverse LPT cemetery located on a rocky Hawasina outcrop. Tomb 1 is a low, disturbed, sub-circular (3.8x3.7m) possible Cell Grave with a double wall of limestone slabs with a packing of smaller stones; the walls are preserved to 80cm on the southern side but are much lower elsewhere. No surface finds were observed in or around the structure. Tomb 2 is a typical, single-chambered, oval Cell Grave (3.9x2.8m), with double walls constructed from slabs of angular bedrock surrounding an oval chamber. Roofing slabs are present but are not in situ and the structure stands to a height of 90cm. A number of sherds of Early Islamic blue/aquamarine glazed Turq were found nearby.

P-25 consists of a cluster of ~10 single and multiple-chambered Cell Graves on the top of a very tall hill of Quaternary fluvial material that forms part of a much larger LPT cemetery. Tomb 1 is a typical oval, small Cell Grave (3.9x3.3), with a double wall of wadi cobbles with a packing of small pieces of broken cobbles in between. The corbelling of the walls of the oval chamber remains partially preserved to a height of 70cm. A sherd of a fine, incised Late Islamic redware was found in the vicinity of the tomb. Tomb 2 is a very well preserved, multiple-chambered Cell Grave — its seven oval chambers, individually very similar to Tomb 1, are arranged in a rough line, sharing walls, along with a 'tail' of a single curved course of wadi cobbles at the northern end to form a single structure over 23m in length. A large quantity of pot sherds were found in the vicinity of the tomb, including: more sherds of fine, incised Late Islamic redware; a few sherds of other coarser Late Islamic wares; Early Islamic blue/aquamarine Turq; and a single sherd of Early Islamic blue glass.

B.3 Incidental sites of special interest (SOSIs)

SOSI-1 is located in Wadi Jizzi (24.3870°N, 56.5474°E), at the top of a small gully between two hills and consists of a number of ephemeral stone features across a small area including a stone pile, possible hearths and a 2m stone semi-circular feature (Figure B.1). The site yielded some red chert material that may have been anthropogenic but was not clearly diagnostic. Hafit tombs surround the site on hills on three sides. The site is very reminiscent of the remains recorded during the Desert Surface Survey (Chapter 7).

SOSI-2 is located on the southern bank of Wadi Jizzi (24.3439°N, 56.5205°E), on the plain at the base of some rocky foothills with Hafit tombs. It consists of a large site of probable Umm an-Nar tombs, as well as other straight-walled structures (Figure B.2). Some possible sugarlumps are present as well as some sherds of probable third

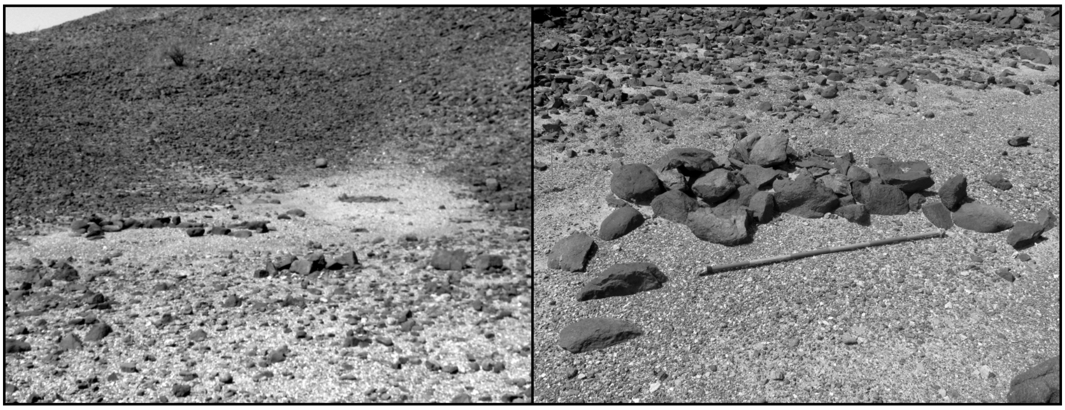

Figure B.1: Ephemeral stone features at SOSI-1

millennium orange pottery and some very fine-grained chert. I brought the site to the attention of the Dutch team working in Wadi Jizzi, and they suspect that it is the MHC site of Willy which has not been published. The site has been badly damaged by bulldozing.

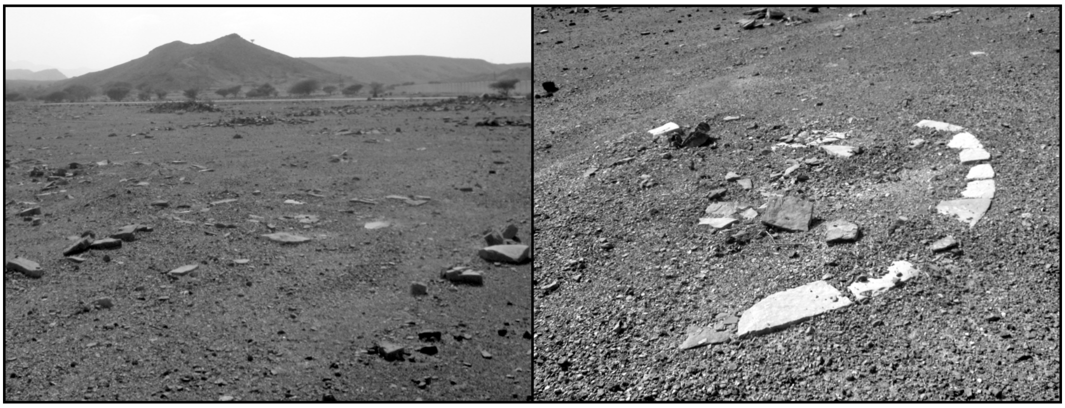

Figure B.2: SOSI-2 — probable Umm an-Nar site

SOSI-3 is located to the south of the main road running through the Saham transect (24.0141°N, 56.7845°E), on a terrace overlooking a wide wadi plain and directly in the path of the planned route of the Batinah Express Highway. It consists of a scatter of chert flakes, cores and debitage, as well as small, curved ephemeral stone structures and other small stone features (Figure B.3). It is surrounded by a number of disturbed Hafit tombs. I brought the site to the attention of the British team working on Phases 3 and 4 of the BEH (Saunders 2016: 101–106).

SOSI-4 is located to the west of the Wadi Haimli road running through the Suwaiq transect (23.7185°N, 57.2738°E), only a few kilometres from the Desert Surface Survey site of al-Buyraq. It is situated in a flat area surrounded by hills on three sides. The

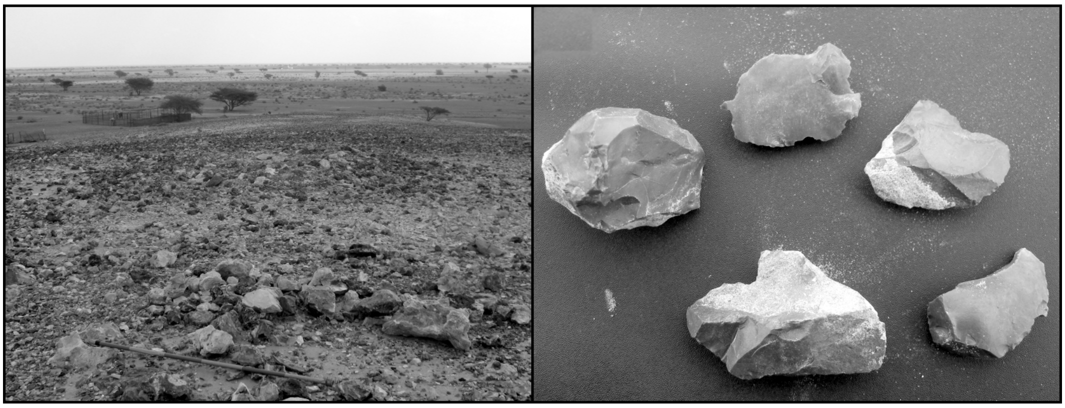

Figure B.3: SOSI-3 — possible Neolithic settlement site

site consists of a large number of ephemeral stone features covering a large area (Figure B.4), surrounded by Hafit tombs on the hills which form part of a very large cemetery. The features are very similar to the DDS site (Chapter 7), including stone semi-circles, possible hearths and rock piles. No pottery was observed.

Figure B.4: Ephemeral stone features at SOSI-4

Appendix C

Neolithic sites

These simple lists of 4th and 5th millennia BC sites were put together for the purpose of examining settlement trends leading up to the Hafit period.

Table C.1: Published 4th millennium BC sites in the northern Oman Peninsula

Name	Code	Settlement	Graves	Multi	Reference
Akab		✓			(Méry, Charpentier, et al. 2009)
Bandah al-Jadidah	BJD			✓	(Charpentier 2008: figure 1)
Bandar Jissah	BJ-1				(Uerpmann and Uerpmann 2003: 94–97)
B'ira Bira	BB-1				(Biagi 1988: table 1)
ad-Daffah	DHF			✓	(Charpentier 2008: figure 1)
Dagmar	DG-1				(Biagi 1988: table 1)
Jebel Abiyad					(Charpentier 2008: figure 1)
Khabbah	KHB			✓	(Charpentier 2008: figure 1)
Khawr Jaramah	KJ-12				(Charpentier 2008: figure 1; Biagi 1988: table 1)
Khor Milkh	KM-1		✓		(Uerpmann and Uerpmann 2003: 101–122; Phillips and Wilkinson 1979)
Khuwaymah	KHU			✓	(Charpentier, Berger, et al. 2012: 68–69)
	KHU-2	✓	✓		(Charpentier, Berger, et al. 2012: 69–72)
Qurum North	QN-1				(Uerpmann and Uerpmann 2003: 74–76)
Ra's al-Hadd	HD			✓	(Charpentier 2008: figure 1)
	HD-5	✓			(Borgi et al. 2012: 31–32)
Ra's al-Hamra	RH-5	✓	✓		(Marcucci et al. 2011; Salvatori 2007)
	RH-10		✓		(Santini 1987b)
Ra's al-Jinz	RJ			✓	(Charpentier 2008: figure 1)
	RJ-2	✓			(Cleuziou and Tosi 2000: 28)
Ruways	RWY			✓	(Charpentier 2008: figure 1)
Sulayb	SLB			✓	(Charpentier 2008: figure 1)
Suwayh	SWY			✓	(Charpentier 2008: figure 1)
	SWY-2	✓			(Charpentier, Blin, et al. 1998)
Wadi Shab	GAS-1	✓	✓		(Gaultier et al. 2005)
Wadi Wutayya	WW				(Uerpmann and Uerpmann 2003: 27–72)
al-Wudayyah	WDY			✓	(Charpentier 2008: figure 1)

Table C.2: Published 5th millennium BC sites in the northern Oman Peninsula

Name	Code	Settlement	Graves	Multi	Reference
Abu Dhabi Airport					(Kallweit 2004)
Akab		✓			(Charpentier and Méry 2008)
Bandar Khayran	BK	✓	✓	✓	(Biagi 1988: 271)
B'ira Bira	BB-1				(Uerpmann 1992a; Biagi 1988: 274)
Daffah	DHF-2				(Charpentier 2008: figure 1)
Daghmar	DG-1				(Uerpmann and Uerpmann 2003: 18)
Dalma		✓			(Beech and Elders 1999)
Dibab	DB-1				(Biagi 1988: 273)
Al-Hamriya					(Magee et al. 2009)
Jabal al-'Aluya		✓	✓		(Lemée et al. 2013)
Jabal Buhais	BHS-18	✓	✓		(Uerpmann et al. 2000)
Jabal Fayah	FAY-NE15	✓	✓		(Uerpmann, de Beauclair, et al. 2012)
Jazirat al-Hamra	JH57				(Beech and Kallweit 2001: 17)
Kharimat Khor Al Manahil	KHM	✓			(Cuttler, Beech, et al. 2007; Beech, Kallweit, Cuttler, et al. 2006; Kallweit, Beech, et al. 2005)
Khor Al Manahil	KAM				(Cuttler, Beech, et al. 2007; Beech, Kallweit, Cuttler, et al. 2006; Kallweit, Beech, et al. 2005)
Khor al-Hajar	KHJ KHJ-1			✓	(Charpentier 2008: figure 1) (Charpentier 2008: figure 1)
Khor Kalba	KK1				(Phillips and Mosseri-Marlio 2002)
al-Khuwaymah	KHU-2	✓	✓		(Charpentier, Berger, et al. 2012: 69–72)
Lizq	Lizq-3				(Weisgerber 1981: 256–258)
al-Madar	site 69				(Uerpmann and Uerpmann 1996)
Marawah	MR11	✓	✓		(Beech, Cuttler, et al. 2005)
MKN	MKN			✓	(Charpentier 2008: figure 1)
Qi Haid					(Charpentier, Berger, et al. 2012: 57–59)
Ramlah	RA-3				(Uerpmann and Uerpmann 1996)
Ra's al-Hadd	HD				(Charpentier 2008: figure 1)
Ra's al-Hamra	RH RH-5 RH-6	 ✓ 	 ✓	✓ 	(Uerpmann and Uerpmann 2003: 5–10) (Marcucci et al. 2011) (Zazzo, Munoz, Badel, et al. 2016; Uerpmann and Uerpmann 2003: 6; Biagi and Nisbet 1999)
Ra's al-Jinz	RJ			✓	(Charpentier 2008: figure 1)
Ra's al-Khabbah	KHB-1	✓			(Cavulli and Scaruffi 2012)
Ra's Jibsh					(Charpentier, Berger, et al. 2012: 62–65)
Ra's Shaqallah	SAQ-1				(Biagi 1988: 280–282; Charpentier, Berger, et al. 2012: 62)
Rumaitha	RU-9				(Kallweit and Hellyer 2003)
Ruways	RWY-1				(Charpentier 2008: figure 1)
Saruq	WS-5				(Uerpmann and Uerpmann 2003: 14–15, 78–93)
Sayq					(Pullar 1974: 33)
Shiya	SHI-4				(Charpentier 2008: figure 1)
Sih Huwayah					(Copeland and Bergne 1976)
Suwayh	SWY SWY-1	 ✓	 ✓		(Charpentier 2008: figure 1) (Charpentier, Marquis, et al. 2003)
Wadi Wutayya	WW				(Uerpmann and Uerpmann 2003: 12–13, 27–62)
Wudayyah	WDY-1				(Charpentier 2008: figure 1)
al-Zuhra					(Haerinck 1991a)

Appendix D

Entrance orientation data for Hafit tombs

The following is a list of the orientation of the entrances of published Hafit tombs, and those measured by the present author, compiled for comparison with the entrances observed in the Batinah.

Table D.1: Entrance orientation data for Hafit tombs

Site	Tomb	Azimuth	UTM 40N (E, N)	Reference
(Batinah Groundtruthing)	H-19-1	~315°	460483, 2682373	(Chapter 5.3.2)
	H-21-2	~157.5°	448673, 2707707	(Chapter 5.3.2)
al-Hamid	HMD-02	145°	504105, 2639429	(Chapter 6.4.3)
	HMD-04	320°	504112, 2639419	(Chapter 6.4.3)
	HMD-07	242°	504134, 2639410	(Chapter 6.4.3)
	HMD-13	4°	504109, 2639380	(Chapter 6.4.3)
Halban	HLB-02	111°	606402, 2608149	(Chapter 6.4.1)
	HLB-09	110°	606383, 2608085	(Chapter 6.4.1)
	HLB-13	108°	606355, 2608119	(Chapter 6.4.1)
	HLB-17	120°	606338, 2608100	(Chapter 6.4.1)
	HLB-22	102°	605992, 2607968	(Chapter 6.4.1)
Wadi al-Hoqain	HQN-01	204°	534481, 2608451	(Chapter 6.4.2)
	HQN-03	140°	534457, 2608270	(Chapter 6.4.2)
	HQN-07	260°	534406, 2608138	(Chapter 6.4.2)
Al Ain	H1	104°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H10	222°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H11	233°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H12	228°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H13	216°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H14	224°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H15	227°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H16	228°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H17	231°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H18	216°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H19	242°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H20	217°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H22	240°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H23	236°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)

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continued

Site	Tomb	Azimuth	UTM 40N (E, N)	Reference
	H24	237°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H28	265°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H29	264.5°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H30	225.5°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H31	294°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H5	273°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H6	225°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H7	215°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H9	224°	496100, 2567500	(Belmonte and Gonzalez-Garcia 2014: table 1)
Bat	H1	276°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H10	285.5°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H2	230.5°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H3	302°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H4	267°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H5	245°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H6	266°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H7	274.5°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H8	280°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H9	295°	474800, 2571700	(Belmonte and Gonzalez-Garcia 2014: table 1)
Bat (Khutm)	H1	106°	471300, 2574200	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H3	266°	471300, 2574200	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H4	267°	471300, 2574200	(Belmonte and Gonzalez-Garcia 2014: table 1)
Fulayj	F-025	127°	607186, 2528534	(Deadman 2014: fieldwork)
	F-027	95°	607206, 2528539	(Deadman 2014: fieldwork)
	F-029	88°	607225, 2528554	(Deadman 2014: fieldwork)
	F-032	88°	607244, 2528583	(Deadman 2014: fieldwork)
	F-034	124°	607261, 2528600	(Deadman 2014: fieldwork)
	F-046	102°	607340, 2528536	(Deadman 2014: fieldwork)
	F-048	120°	607156, 2528635	(Deadman 2014: fieldwork)
	F-049	121°	607149, 2528664	(Deadman 2014: fieldwork)
	F-050	109°	607147, 2528659	(Deadman 2014: fieldwork)
	F-052	82°	607122, 2528380	(Deadman 2014: fieldwork)
	F-053	82°	607122, 2528379	(Deadman 2014: fieldwork)
	F-054	100°	607128, 2528368	(Deadman 2014: fieldwork)
	F-055	92°	607110, 2528189	(Deadman 2014: fieldwork)
	F-056	88°	607097, 2528166	(Deadman 2014: fieldwork)
	F-057	118°	607092, 2528169	(Deadman 2014: fieldwork)
Jabal al-Emalah	I	~270°	381200, 2770200	(Benton and Potts 1994: 27, figure 36)
	III	~270°	381200, 2770200	(Benton and Potts 1994: 20, figure 25)
Jabal Buhais	88	~270°	379100, 2766900	(Jasim 2012: 126)
Jabal Hafit	17	~180°	375472, 2674623	(Frifelt 1971: 377, figure 8)
Kalba	2	~270°	434400, 2768400	(Eddisford and Phillips 2009: 112, figure 4)
	1A	~315°	434400, 2768400	(Eddisford and Phillips 2009: 111)
	1B	~315°	434400, 2768400	(Eddisford and Phillips 2009: 111)
Khashbah	K-019	94°	604318, 2506306	(Deadman 2014: fieldwork)
	K-023	106°	604284, 2506297	(Deadman 2014: fieldwork)
	K-024	88°	604272, 2506298	(Deadman 2014: fieldwork)
	K-025	98°	604244, 2506296	(Deadman 2014: fieldwork)
	K-028	104°	604212, 2506308	(Deadman 2014: fieldwork)
	K-029	106°	604203, 2506313	(Deadman 2014: fieldwork)
	K-048	96°	603964, 2506199	(Deadman 2014: fieldwork)
	K-051	94°	603948, 2506182	(Deadman 2014: fieldwork)
	K-052	92°	603935, 2506171	(Deadman 2014: fieldwork)

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continued

Site	Tomb	Azimuth	UTM 40N (E, N)	Reference
	K-054	114°	603918, 2506160	(Deadman 2014: fieldwork)
	K-069	104°	604252, 2506145	(Deadman 2014: fieldwork)
Khubayb	S007-003	~225°	415661, 2614428	(Williams and Gregoricka 2013: 143)
Maysar	22:5	~90°	614628, 2518858	(Weisgerber 1980: 92)
	25:1	~135°	615208, 2519019	(Weisgerber 1981: figure 26)
	25:2	~135°	615216, 2519013	(Weisgerber 1981: figure 26)
Mazyad (Jabal Hafit)	H10	168°	378100, 2659700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H11	178°	378100, 2659700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H12	185°	378100, 2659700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H13	168.5°	378100, 2659700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H14	172.5°	378100, 2659700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H15	194.5°	378100, 2659700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H20	186°	378100, 2659700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H21	167°	378100, 2659700	(Belmonte and Gonzalez-Garcia 2014: table 1)
	H8	200°	378100, 2659700	(Belmonte and Gonzalez-Garcia 2014: table 1)
Qarn Bint Saud	11	~270°	370142, 2697475	(Vogt 1985b: 66)
Ra’s al-Hadd	3.1	~90°	787400, 2492000	(Salvatori 2001: 67, figure 2)
	4.1	~90°	787400, 2492000	(Salvatori 2001: 70, figure 4)
	4.2	~90°	787400, 2492000	(Salvatori 2001: 70, figure 5)
Ra’s al-Jinz	6.1	~135°	791300, 2482100	(Santini 1987a: 33, figure 32)
Shariq	Sha5	140°	697700, 2530600	(Yule and Weisgerber 1998: 210)
	Sha8	~135°	700115, 2535782	(Yule and Weisgerber 1998: 211)
Shenah	ST103	~90°	678882, 2531921	(al-Belushi and ElMahi 2009: 34)
Shir	1	90°	710909, 2524518	(Yule and Weisgerber 1998: 211)
	2	150°	710923, 2524633	(Yule and Weisgerber 1998: 215)
	3	140°	711054, 2524485	(Yule and Weisgerber 1998: 216)
	4	120°	710991, 2524501	(Yule and Weisgerber 1998: 217)
	6	90°	710920, 2524674	(Yule and Weisgerber 1998: 218)
	7	100°	710833, 2524774	(Yule and Weisgerber 1998: 218)
	8	80°	710701, 2524723	(Yule and Weisgerber 1998: 218–219)
	9	120°	710641, 2524729	(Yule and Weisgerber 1998: 219)
	10	120°	712372, 2523605	(Yule and Weisgerber 1998: 220)
	11	80°	712393, 2523524	(Yule and Weisgerber 1998: 222)
	12	95°	712417, 2523475	(Yule and Weisgerber 1998: 222)
	17	340°	711742, 2524898	(Yule and Weisgerber 1998: 224)
	19	100°	711480, 2525487	(Yule and Weisgerber 1998: 225)
	20	120°	711432, 2525557	(Yule and Weisgerber 1998: 225)
	21	120°	711271, 2525682	(Yule and Weisgerber 1998: 225)
	23	90°	710919, 2524513	(Yule and Weisgerber 1998: 226)
	25	90°	711372, 2524724	(Yule and Weisgerber 1998: 229)
	26	105°	711289, 2524605	(Yule and Weisgerber 1998: 229)
	27	80°	710492, 2526096	(Yule and Weisgerber 1998: 229)
	28	120°	710794, 2523971	(Yule and Weisgerber 1998: 229)
	40	90°	711333, 2525163	(Yule and Weisgerber 1998: 233)
	49	90°	712447, 2522668	(Yule and Weisgerber 1998: 234)
	51	90°	712430, 2522668	(Yule and Weisgerber 1998: 236)
	54	90°	712211, 2522751	(Yule and Weisgerber 1998: 236)
	57	120°	712519, 2523867	(Yule and Weisgerber 1998: 237)
Tawi Silaim	1	~90°	670400, 2493100	(de Cardi, Doe, and Roskams 1977: 20, figure 2)
	2	~90°	670400, 2493100	(de Cardi, Bell, et al. 1979: 64, figure 3)
	3	~90°	670400, 2493100	(de Cardi, Bell, et al. 1979: 66, figure 4)
	4	~112.5°	670400, 2493100	(de Cardi, Bell, et al. 1979: figure 5)
Uyun	U-051	94°	608360, 2472630	(Deadman 2014: fieldwork)

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continued

Site	Tomb	Azimuth	UTM 40N (E, N)	Reference
	U-131	73°	607074, 2472723	(Deadman 2014: fieldwork)
	U-143	63°	607263, 2472666	(Deadman 2014: fieldwork)
	U-147	66°	607276, 2472603	(Deadman 2014: fieldwork)
	U-159	64°	607543, 2472687	(Deadman 2014: fieldwork)
	U-160	62°	607623, 2472692	(Deadman 2014: fieldwork)
	U-161	74°	607619, 2472729	(Deadman 2014: fieldwork)
	U-175	74°	607769, 2472555	(Deadman 2014: fieldwork)
	U-178	76°	607748, 2472579	(Deadman 2014: fieldwork)
	U-182	80°	607573, 2472548	(Deadman 2014: fieldwork)
	U-188	62°	607483, 2472501	(Deadman 2014: fieldwork)
	U-190	62°	607455, 2472506	(Deadman 2014: fieldwork)
	U-192	72°	607506, 2472539	(Deadman 2014: fieldwork)
	U-197	72°	608147, 2472371	(Deadman 2014: fieldwork)
	U-198	79°	608191, 2472380	(Deadman 2014: fieldwork)
	U-206	68°	608427, 2472425	(Deadman 2014: fieldwork)

Appendix E

Arabic placenames

Arabic placenames referred to and transliterated approximately when describing remote sensing or fieldwork in the main text are provided in the original script below.

Barka	بركاء	ar-Rustaq	الرستاق
al-Batinah	الباطنة	Saham	صحم
al-Buyraq	البويرق	Shinas	شناص
Falaj al-Harth	فلج الحارث	Sohar	صحار
Falaj al-Qabail	فلج القبائل	as-Suwayq	السويق
Falaj as-Saidi	فلج السيدي	Tamr Abu Fudalah	تمر أبو فضالة
Halban	حلبان	Wadi al-Haimli	وادي الحيملي
al-Hamid	الحمض	Wadi al-Hoqain	وادي الحوقين
Hoqain	حوقين	Wadi al-Jizzi	وادي الجزي
Izz	عز	Wadi Khawan	وادي خون
al-Khaburah	الخابورة	Wadi al-Mawa'il	وادي المعاول
Liwa	لوى	Wadi Rajmi	وادي رجمي
al-Mussanah	المصنعة	Wadi as-Sahtan	وادي السحتن
Nakhal	نخل	Wadi Taww	وادي طو

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